DESMIDS OF ARCTIC ALASKA

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Introduction

Through the kindness of Prof. H. FUKUSHIMA of the Yokohama Municipal University, the writer had the rare opportunity to study the desmid samples of Alaska collected by Mr. K. MARUYAMA, a member of the Japanese Microbiological Expedition to the Alaskan Arctic in the summer of 1965, led by Dr. Y. KOBAYASI, National Science Museum, Tokyo. Knowledge about Alaskan fresh-water algae, especially desmids, was recently increased by the studies of WHELDEN, CROASDALE, GRÖNBLAD, PRESCOTT and others. However, phycological information on the adjacent districts, especially those covering the islands of Arctic Canada, extending from Continental America to Greenland, and the western parts of the Aleutian Islands, is not sufficient as yet.

The collections were made chiefly in the four areas within the Arctic circle, and these are summarized in the following list:

1. Cape Thompson area

Habitat no. 143: M, St.-2, 5 cm depth, 4.7 w.t. Aug. 15, 1965.
.. no. 146: M. St.-4, 5 cm depth, Aug. 15.
.. no. 148: M, St.-5, 5 cm depth, Aug. 15.
.. no. 158: Sp, Sw-, n-St-7, 5 cm depth, Aug. 15.
.. no. 160: M, St.-7, 5 cm depth, Aug. 15.
.. no. 169: M, St.-10, 5 cm depth, Aug. 15.
.. no. 172: Mu, Cr-1, 10 cm depth, Aug. 15.
. no. 173: Mu, Cr-1, 10 cm depth, Aug. 15.
.. no. 536: GD, Sw-, n-Cr-1, 30 cm depth, Aug. 15.
.. no. 538: Mu, Sw-, n-Cr-1, 30 cm depth, Aug. 15.

2. Barrow area

Habitat no. 2: Mu, Po-1, 5 cm depth, BV, Aug. 2, 1965.
.. no. 6: FB, Po-4, 10 cm depth, 4.7 a.t., 8.4 w.t., 6.0 pH, PB-BB, Aug. 4.
.. no. 14: Sp, Pn-3, 20 cm depth, 13.4 w.t., s-BV, Aug. 5.
.. no. 15: GD, Pn-3, 20 cm depth, 13.4 w.t., s-BV, Aug. 5.
.. no. 16: GD, Pn-3, 20 cm depth, 13.4, w.t., s-BV, Aug. 5.
.. no. 22: Mu, Pn-4, 20 cm depth, s-BV, Aug, 5.

Habitat no. 25: FB, Pn-8, 30 cm depth, 8.1 w.t., 5.4 pH, SBB, Aug. 5.
.. no. 26: M, Pn-8, 30 cm depth, 8.1 w.t., 5.4 pH, SBB, Aug. 5.
.. no. 28: M, Pn-8, 30 cm depth, 8.1 w.t., 5.4 pH, SBB, Aug. 5.
.. no. 29: Mu, Pn-9, 20 cm depth, s-BB, Aug. 5.
.. no. 30: Mu, Pn-9, 20 cm depth, s-BB, Aug. 5.
.. no. 33: Mu, Sw-3, b-Pn-6, 10 cm depth, s-BV, Aug. 6.
.. no. 36: GD, Sw-3, b-Pn-6, 10 cm depth, s-BV, Aug. 6.
.. no. 38: Mu, Sw-4, n-Pn-7, 10 cm depth, 50 cm depth, s-BV, Aug. 6.
.. no. 39: Mu, Sw-4, n-Pn-7, 10 cm depth, 50 cm depth, s-BV, Aug. 6.
.. no. 40: Mu, Sw-4, n-Pn-7, 10 cm depth, 50 cm depth, s-BV, Aug. 6.
.. no. 43: GD, St-1, n-Pn-7, 30 cm depth, 10.2 w.t., 5.8 pH, s-BV, Aug. 6.
.. no. 44: Mu, St-1, n-Pn-7, 30 cm depth, 10.2 w.t., 5.8 pH, s-BV, Aug. 6.
.. no. 45: GD, St-1, n-Pn-7, 30 cm depth, 10.2 w.t., 5.8 pH, s-BV, Aug. 6.
.. no. 53: GD, Pn-10, 30 cm depth, 5.8 w.t., 5.4 pH, s-BB, Aug. 7
.. no. 55: Mu, Sw-5, b-Pn-10, 10 cm depth, s-BB, Aug. 7.
.. no. 56: Mu, Sw-5, b-Pn-10, 10 cm depth, s-BB, Aug. 7.
.. no. 57: FB, Sw-5, b-Pn-10, 10 cm depth, s-BB, Aug. 7.
.. no. 58: GD, Sw-5, b-Pn-10, 10 cm depth, s-BB, Aug. 7.
.. no. 59: FB, Sw-6, n-PG, 10 cm depth, 8.8 w.t., s-BB, Aug. 7.
.. no. 61: M, Sw-6, n-PG, 10 cm depth, 8.8 w.t., s-BB, Aug. 7.
.. no. 64: M, Sw-8, n-PG, 10 cm depth, s-BB, Aug. 7.
.. no. 65: M, Sw-8, n-PG, 10 cm depth, s-BB, Aug. 7.
.. no. 72: M, Pn-11, 20 cm depth, 4.9 w.t., 5.6 pH, s-BB, Aug. 9.
.. no. 74: Mu, Sw-9, b-Pn-11, 10 cm depth, 8.2 w.t., s-BB, Aug. 9.
.. no. 76: M, Sw-9, b-Pn-11, 10 cm depth, 8.2 w.t., s-BB, Aug. 9.
.. no. 93: Pl, Pn-14, 20 cm depth, 8.0 w.t., s-BB, Aug. 10.
.. no. 94: M, Pn-14, 20 cm depth, 8.0 w.t., s-BB, Aug. 10.
.. no. 513: M, Sw-7, n-PG, 10 cm depth, s-BB, Aug. 7.
.. no. 523: G, Cr-1, 50 cm depth, 5.2 w.t., 5.8 pH, s-BV, Aug. 6.

3. Umiat area

Habitat no. 104: M, Cr-1, 5 cm depth, 13.0 w.t., Aug. 11.
.. no. 105: Mu, Cr-1, 5 cm depth, 13.0 w.t., Aug. 11.
.. no. 106: Mu, Cr-1, 5 cm depth, 13.0 w.t., Aug. 11.
.. no. 110: Pl, Pn-2, 30 cm depth, Aug. 12.
.. no. 112: Sp, Pn-3, 50 cm depth, 12.1 w.t., Aug. 12.
.. no. 115: Mu, Pn-3, 50 cm depth, 12.1 w.t., Aug. 12.
.. no. 116: M, Pn-3, 50 cm depth, 12.1 w.t., Aug. 12.

Habitat no. 117: FB, Pn-3, 50 cm depth, 12.1 w.t., Aug. 12.
.. no. 118: Pl, Pn-4, 30 cm depth, 10.4 w.t., 5.8 pH, Aug. 12.
.. no. 119: Mu, Pn-4, 30 cm depth, 10.4 w.t., 5.8 pH, Aug. 12.
.. no. 123: F, Pn-6, 150 cm depth, 12.2 w.t., Aug. 12.
.. no. 530: G, L-, 30 cm depth, 15.8 a.t., 13.0 w.t., 5.8 pH, Aug. 13.

4. Lake Peters area

Habitat no. 190: Mu, St-2, 5 cm depth, 8.8 w.t., Aug. 19.
.. no. 193: Mu, St-3, 5 cm depth, Aug. 19.
.. no. 199: G, St-6, 5 cm depth, 7.0 w.t., Aug. 19.
.. no. 203: Mu, St-8, 5 cm depth, Aug. 19.
.. no. 205: G, St-10, 5 cm depth, Aug. 19.
.. no. 223: M, Sw, n-St-12, 10 cm depth, Aug. 20.
.. no. 515: FB, L-4, 10 cm depth, Aug. 19.
.. no. 516: Mu, L-1, 10 cm depth, 6.5 w.t., 5.8 pH, Aug. 19.

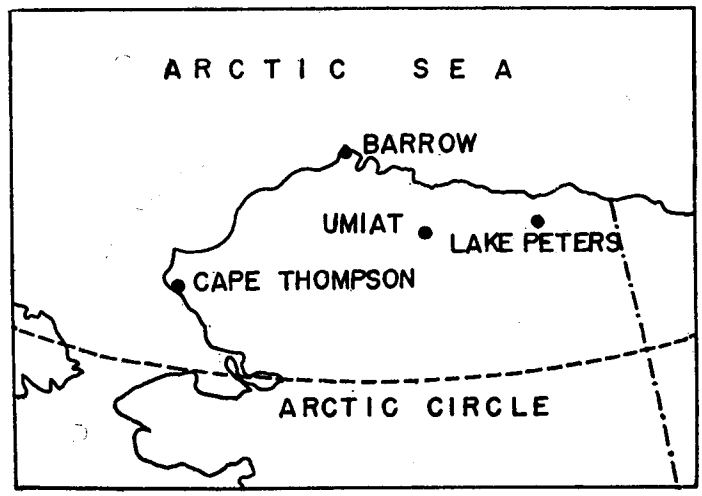

Fig. 1. Map of the Alaskan Arctic.

Abbreviation

B-: Beside
BB: Barrow Base
BV: Barrow village
Cr: Creek
F: Float
FB: Float on the bottom

G: Attached to the grass in the water
GD: Attached to the grass deposit in the water
L: Lake
M: Attached to the moss in the water
Mu: On the mud in the water
n-: Near
PB: Point Barrow
Pl: Plankton
Pn: Pond
Po: Pool
s-: South to
Sp; In the Sphagna
St: Stream
Sw: Swal

In the present paper more than two hundred species of desmids are identified, and about one half of them belong to the genus *Cosmarium*. This high percentage of *Cosmarium*-species in the arctic desmid-flora has already been pointed out by CROASDALE on the desmid-flora of Devon Island, with the scantiness of *Triploceras* and *Micrasterias*. The most frequent species found in the present collections are the following:

Closterium dianae, Cl. parvulum, Cl. striolatum, Pleurotaenium truncatum, Cosmarium costatum, forma *minor, C. granatum, C. holmiense* var. *integrum, C. botrytis, C. cyclicum* var. *arcticum, C. subcrenatum, C. subcostatum, C. quadratum, C. turpinii* var. *eximium, C. ochthodes* var. *amoebum, C. tumidum, Euastrum bidentatum, E. binale* var. *gutwinskii, E. obesum. E. elegans, Staurastrum borgeanum.*

However, all these species are not always the arctic species, and true arctic and noteworthy species are found rather rarely in the samples collected in some districts. Some of the species are particularly interesting in distribution and they have been previously known chiefly from the European side of the Arctic. These are the following:

Closterium elenkinii, Cosmarium botrytis var. *gemmiferum, C. anceps* and its forma *crispula* and f. *subparvula, C. incertum* var. *groenlandicum, C. hornavanense* var. *arcticum* and var. *dubovianum, C. hexalobum* var. *laticeps, C. hians, C. microsphinctum, C. subglobosum, C. subquasillus, C. subundulatum, C. tuddalense, C. subcostatum* var. *spetsbergense, C. woronichinii, C. speciosissimum, Staurastrum bieneanum* forma *spetsbergensis, St. insigne, St. petsamoense* and var. *minus.*

The writer expresses his hearty thanks to Dr. Y. KOBAYASI of the National Science Museum, and to Dr. K. MARUYAMA of the Institute of Applied Microbiology, University of Tokyo. Gratitude is expressed also to the Arctic Institute of North America for the kind invitation to the present survey of botany.

Gonatozygaceae

Gonatozygon monotaenium DE BARY in W. & G. S. WEST, Monogr. Br. Desm., **1**, p. 30, pl. 1, f. 1-7; pl. 5, f. 5, 1904; CROASDALE, Farlowia, **4**, p. 519, pl. 3, f. 1, 1955; FÖRSTER,

Ark. Bot., Ser. 2, **6**(3), p. 124, pl. 1, f. 3, 4, 1965.

Cells 220–255μ long, 13–13.4μ broad, and apices 15–15.8μ broad.

Hab. 30, 40, 523. Distr. Devon Island, Europe, and America.

Mesotaeniaceae

Cylindrocystis brebissonii MENEGH. in W. & G. S. WEST, Monogr. Br. Desm., **1**, p. 58, pl. 4, f. 23–32, 1904; KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 207, pl. 6, f. 4–7, 1933; SKUJA, Nava Acta R. Soc. Scient. upsal., Ser. IV, **18**(3), p. 177, pl. 29, f. 16–18, 1963.

Cells 44–64μ long and 18.5–22μ broad.

Hab. 29, 30, 61, 74, 94, 193, 205, 515, 516, 523. Distr. Greenland, Spitzbergen, Novaya Semlya, Franz Joseph Land, Devon Island, Europe, Asia, and N. America.

Cylindrocystis brebissonii var. *minor* W. & G. S. WEST, Monogr. Br. Desm., **1**, p. 59, pl 5, f. 11, 1904; KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 209, pl. 6, f. 8, 9, 1933; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. IV, **18**(3), p. 177, 1963.

Cells 41.7–42μ long and 11–11.4μ broad.

Hab. 203. Distr. Europe and Japan.

Spirotaenia condensata BRÉB. in W. & G. S. WEST, Monogr. Br. Desm., **1**, p. 38, pl. 2, f. 7–10, 1904; KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 181, pl. 2, f. 1, 1933.

Cells 132–145μ long and 22.7–24μ broad.

Hab. 115. Distr. Alaska, Spitzbergen, Novaya Semlya, Europe, and Japan.

Spirotaenia obscura RALFS in W. & G. S. WEST, Monogr. Br. Desm., **1**, p. 44, pl. 3, f. 7–12, 1904; KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 180, pl. 1, f. 5, 6, 1933.

Cells 118–120μ long and 22.6–23μ broad.

Hab. 223. Distr. Spitzbergen, Novaya Zemlya, Europe, U.S.A., and Japan.

Netrium digitus (EHRENB.) ITZIG. & ROTHE in W. & G. S. WEST, Monogr. Br. Desm., **1**, p. 64, pl. 6, f. 14–16, 1904; KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 214, pl. 7, f. 1; pl. 8, f. 1, 1933.

Hab. 57, 61, 115. Distr. Gosmopolitan.

Netrium oblongum (DE BARY) LÜTKEM. in W. & G. S. WEST, Monogr. Br. Desm. **1**, p. 66, pl. 8, f. 1–3, 1904; KRIEGER, Kryptogemenflora, **13**, Abt. 1, p. 220, pl. 8, f. 6, 1933.

Hab. 61. Distr. Europe, N. & S. America, Japan, and India.

Desmidiaceae

Penium margaritaceum (EHRENB.) BRÉB. in WEST, Monogr. Br. Desm., **1**, p. 83, pl. 8, f. 32–35, 1904; KRIEGER, Kryptogamenflora, **13**, Abt, 1, p. 230, pl. 10, f. 2–4, 1935.

Cells 88–150μ long and 24–28μ broad.

Hab. 30, 106, 516. Distr. Alaska, Greenland, Spitzbergen, Europe, U.S.A., Devon Island, Japan, and Java.

Penium polymorphum PERTY in W. & G. S. WEST, Monogr. Br. Desm., **1**, p. 90, pl. 9, f. 9–11, 1904; KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 229, pl. 11, f. 18–20, 1935; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. IV, **18**(3), p. 179, pl. 30, f. 7, 8, 1963.

Cells 70–75μ long and 22–26.4μ broad.

Hab. 40, 44, 72, 104. Distr. Europe, U.S.A., Japan, and New Zealand.

Penium spirostriolatum BARKER in W. & G. S. WEST, Monogr. Br. Desm., **1**, p. 88, pl. 9, f. 1–8, 1904; KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 227, pl. 9, f. 1–6, 1935.

Cells 136–140μ long and 26–26.5μ broad.

Hab. 61. Distr. Europe, U.S.A., Japan, Java, and Ceylon.

Closterium acerosum (SCHRANK) EHRENB. in KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 314, pl. 23, f. 11, 12; pl. 24, f. 1, 1935.

Closterium acerosum var. *nasutum* HIRANO, var. nov.

Cellulae minores quam in forma typica, circiter 8–9 longiores quam latiores, gradatim attenuatae ad verticem, apicibus rotundatis, marginibus internis paene rectis vel leviter concavis; membrana glabra. Long. 250–277μ, lat. 27–31μ.

The specimens are not recurved or conically attenuated near the apex. Cell outline rather resembles var. *elongatum* but is shorter. Pl. 2, fig. 3.

Hab. 45, 523.

Closterium acerosum var. *porosum* HIRANO, var. nov.

Membrana distincte punctata, sed ceteris in forma typica. Long. 370–414μ, lat. 36–40.5μ.

Cell wall with median girdle and distinctly punctated. MESSIKOMMER reported a similar form from Switzerland under the name of *Closterium pritchardianum* var. *micropunctata* (Arch. Hydrobiol., **47**, p. 550, pl. 4, f. 5, 1953) but the present forms are smaller than his form. Pl. 1, fig. 10.

Hab. 106.

Closterium archerianum CLEVE in W. & G. S. WEST, Monogr. Br. Desm., **1**, p. 115, pl. 11, f. 8–10, 1904; KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 368, pl. 36, f. 7, 8, 1935.

Hab. 56, 112, 115. Distr. Europe, Japan, India, and Java.

Closterium arcuarium HUGHES, Can. J. Bot., **30**, p. 272, f. 23, 27, 57, 1952; CROASDALE, Farlowia, **4**, p. 521, pl. 5, f. 18, 1955.

Cells 186–200μ long and 17.6–18μ broad. Pl. 1, fig. 8.

Hab. 22. Distr. Canada and Alaska.

Closterium calosporum WITTR. in W. & G. S. WEST, Monogr. Br. Desm., **1**, p. 138, pl. 16, f. 1-4, 1904; KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 292, pl. 19, f. 1-3, 1935.

Cells 105-110μ long and 8-8.8μ broad.

Hab. 38. Distr. Novaya Zemlya, Europe, U.S.A., Ceylon, Thailand, and Africa.

Closterium cornu EHRENB. in W. & G. S. WEST, Monogr. Br. Desm., **1**, p. 157, pl. 20, f. 1-5, 1904; CROASDALE & GRÖNBLAD, Trans. Am. microsc. Soc., **83**, p. 154, pl. 2, f. 13-15, 1964.

Cells 123-158μ long and 6.6-10μ broad.

Hab. 53, 61, 65, 190. Distr. Labrador. U.S.A., Novaya Zemlya, Europe, Japan, Thailand, Java, and Central Africa.

Closterium costatum CORDA in W. & G. S. WEST, Monogr. Br. Desm., **1**, p. 120, pl. 13, f. 1-3, 1904; KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 358, pl. 34, f. 1-3, 1935; CROASDALE & GRÖNBLAD, Trans. Am. microsc. Soc., **83**, p. 154, pl. 4, f. 13, 1964.

Cells 343-427μ long and 40-57μ broad.

Hab. 22, 36, 112. Distr. Canada, Greenland, Europe, Faeroes, U.S.A., and Japan.

Closterium costatum var. *subcostatum* (NORDST.) KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 360, pl. 34, f. 6, 1935.

Cells 310-318μ long, 52-53μ broad, and striae 4 in 10μ. Pl. 2, fig. 4.

Hab. 61. Distr. U.S.A., Europe, India, and Brazil.

Closterium cynthia DE NOT. in W. & G. S. WEST, Monogr. Br. Desm., **1**, p. 113, pl. 11, f. 1-3, 1904; CROASDALE & GRÖNBLAD, Trans. Am. microsc, Soc., **83**, p. 154, pl. 5, f. 4, 1964.

Cells 84-101μ long and 13-15.4μ broad.

Hab. 29, 58, 61, 74. Distr. N. America, Europe, Japan, India, Ceylon, Sumatra, E. Africa, New Zealand, and Brazil.

Closterium cynthia var. *jenneri* (RALFS) KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 366, pl. 36, f. 2, 1935.

Cells 79-120μ long and 8.7-16μ broad.

Hab. 14, 55, 57, 59. Distr. U.S.A., Greenland, Novaya Zemlya, Europe, Africa, Japan, Thailand, Java, and Brazil.

Closterium cynthia var. *latum* SCHMIDLE in KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 368, pl. 36, f. 3, 4, 1935.

Cells 75-81μ long, 15.4-17.6μ broad, and striae 7 in 10μ.

Hab. 30, 40, 61. Distr. Europe, E. Africa, and Kerguelen.

Closterium dianae EHRENB. in W. & G. S. WEST, Monogr. Br. Desm., **1**, p. 130, pl. 15,

f. 1-6, 1904; CROASDALE, Farlowia **4**, p. 522, pl. 5, f. 1-6, 1955.

Cells 120-295μ long and 13-25μ broad.

Hab. 14, 22, 35, 36, 40, 43, 44, 45, 58, 61, 64, 65, 74, 76, 93, 94, 104, 105, 190, 515, 538. Distr. Cosmopolitan.

Closterium dianae var. *minus* (WILLE) SCHRÖDER in KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 296, pl. 19, f. 15, 1935.

Cells 116-119μ long and 13μ broad.

Hab. 40. Distr. Europe, Japan, and E. Africa.

Closterium didymotocum RALFS in KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 325, pl. 26, f. 1, 2. 1935.

Cells 427-493μ long and 44-49.3μ broad. Pl. 2, fig. 1.

Hab. 55. Distr. Europe, Greenland, Siberia, U.S.A., India, New Zealand, and Africa.

Closterium elenkinii KOSSINSKAYA in Flora Plant. Crypt. URSS, **5**, p. 229, pl. 19, f. 5-8, 1960; CROASDALE, Trans. Am. microsc. Soc., **81**, p. 18, pl. 2, f. 22, 23, 1962.

Cells 300-360μ long and 35-45μ broad. The present specimens are larger in dimension than those of the Russian forms described by KOSSINSKAYA. Cells are prominently tumid in the middle of the cell, rapidly attenuating toward the apices, which are somewhat protruded. Cell walls are punctated but do not show any definite disposition. Pl. 1, fig. 6, 7.

Hab. 22, 55. Distr. Alaska and URSS.

Closterium gracile BRÉB. in W. & G. S. WEST, Monogr. Br. Desm., **1**, p. 166, pl. 21, f. 8-12, 1904; KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 310, pl. 30, f. 7-9, 1935.

Cells 143-220μ long and 7.5-11μ broad.

Hab. 43, 104, 105, 530. Distr. U.S.A., Devon Island, Greenland, Siberia, Europe, SE. Asia, and S. America.

Closterium intermedium RALFS in WEST, Monogr. Br. Desm., **1**, p. 125, pl. 14, f. 1-5, 1904; KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 335, pl. 28, f. 5, 6; pl. 29, f. 8, 1935; CROASDALE & GRÖNBLAD, Trans. Am. microsc. Soc., **83**, p. 156, pl 4, f. 1, 1964.

Cells 163-378μ long, 18.5-23μ broad, and striae 7 in 10μ.

Hab. 29, 43, 64, 119. Distr. Alaska, Canada, U.S.A., Europe, Faeroes, Japan, Ceylon, Australia, and Brazil.

Closterium johnsonii W. & G. S. WEST in KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 309, pl. 23, f. 3, 1935.

Cells 264-268μ long and 17.5μ broad. The present specimens are smaller than those of KRIEGER's conception and the length of cells is about 15 times their breadth,

both sides are almost parallel and inner side is straight. The species resembles *Closterium macilentum* but is not so elongated.

Hab. 43. Distr. U.S.A. and Alaska.

Closterium juncidum RALFS var. *brevior* (RALFS) ROY in W. & G. S. WEST, Monogr. Br. Desm., **1**, p. 129, pl. 14, f. 15, 16, 1904; KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 334, pl. 28, f. 3, 1935; CROASDALE & GRÖNBLAD, Trans. Am. microsc. Soc., **83**, p. 157, pl. 3, f. 19, 1964.

Cells 137–152μ long and 9–9.5μ broad.

Hab. 30. Distr. Alaska, Europe, and U.S.A.

Closterium kutzingii BRÉB. in KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 351, pl. 32, f. 8, 9, 1935; CROASDALE & GRÖNBLAD, Trans. Am .microsc. Soc., **83**, p. 157, pl. 4, f. 11, 12, 1964; FÖRSTER, Ark. Bot., ser. 2, **6**(3), p. 126, pl. 1, f. 17–19, 1965.

Cells 416–638μ long and 22–26.4μ broad.

Hab. 36, 40, 45, 55, 61, 64, 65, 74, 106, 118. Distr. Cosmopolitan.

Closterium lanceolatum KÜTZ. in W. & G. S. WEST, Monogr. Br. Desm., **1**, p. 149, pl. 17, f. 9, 10; pl. 18, f. 7, 1904; KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 319, pl. 24, f. 9, 10, 1935.

Cells 216–232μ long and 30–30.6μ broad.

Hab. 53. Distr. Greenland, U.S.A., Europe, China, Japan, and Africa.

Closterium libellula FOCKE var. *intermedium* (ROY & BISS.) G. S. WEST in KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 255, pl. 12, f. 3–5, 1935.

Hab. 45. Distr. Alaska, Europe, Japan, Ceylon, and Malaya.

Closterium littorale GAY in W. & G. S. WEST, Monogr. Br. Desm., **1**, p. 155, pl. 19, f. 14, 1904; KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 298, pl. 20, f. 3–5, 1935.

Cells 154–160μ long and 17.6–18μ broad.

Hab. 30. Distr. U.S.A., Greenland, Europe, and Japan.

Closterium moniliferum (BORY) EHRENB. in W. & G. S. WEST, Monogr. Br. Desm., **1**, p. 142, pl. 16, f. 15, 16, 1904; KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 289, pl. 18, f. 6, 7, 1935; CROASDALE & GRÖNBLAD, Trans. Am. microsc. Soc., **83**. p. 157, pl. 3, f. 1, 1964.

Cells 194–300μ long and 35–53μ broad.

Hab. 45, 94, 106. Distr. Alaska, Devon Island, U.S.A., Europe, Japan, Ceylon, and Africa.

Closterium navicula (BRÉB.) LÜTKEM. in KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 257, pl. 12, f. 8–10, 1935.

Cells 75–79μ long and 18.5–22μ broad.

Hab. 105. Distr, U.S.A., Greenland, Europe, Japan, India, Ceylon, Malaya, and

Brazil.

Closterium parvulum NÄG. in W. & G. S. WEST, Monogr. Br. Desm., **1** p. 133, pl. 15, f. 9–12, 1904; KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 275, pl. 16, f. 14–17, 1935.

Cells 88–121μ long and 8.8–16μ broad.

Hab. 14, 16, 57, 65, 72, 105, 106, 115, 117, 523, 536. Distr. Cosmopolitan.

Closterium pseudolunula BORGE in KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 305, pl. 22, f. 3, 1935; SKUJA, Nova Acta R. Soc. Scient. Upsal., ser. IV, **18**(3), p. 183, 1963.

Cells 286–297μ long and 36–38μ broad. Pl. 1, fig. 9.

Hab. 106. Distr. U.S.A., Greenland, Spitzbergen, Europe, Sumatra, Africa, and Australia.

Closterium ralfsii BRÉB. var. *gracilius* (MASKELL) KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 346, pl. 31, f. 6, 1935; CROASDALE & GRÖNBLAD, Acta Soc. Fauna Flora Fenn., **83**, p. 158, pl. 4, f. 7. 1964.

Cells 211–370μ long and 18.5–22μ broad.

Hab. 22, 30, 43, 44, 45, 56. Distr. Canada, Europe, Burma, and New Zealand.

Closterium ralfsii var. *hybridum* RABENH. in W. & G. S. WEST, Monogr. Br. Desm., **1**, p. 183, pl. 24, f. 8–13, 1904; KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 347, pl. 31, f. 4, 5, 1935.

Cells 360–506μ long and 33–43μ broad.

Hab. 22, 45, 105, 106. Distr. Cosmopolitan.

Closterium striolatum EHRENB. in W. & G. S. WEST, Monogr. Br. Desm., **1**, p. 122, pl. 13, f. 7–16, 1904; KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 337, pl. 28, f. 8, 9; pl. 29, f. 9, 1935.

Cells 194–334μ long and 22–55μ broad.

Hab. 14, 16, 29, 30, 55, 56, 57, 58, 59, 61, 64, 65, 104, 105, 106, 513. Distr. Alaska, Greenland, Spitzbergen, Novaya Zemlya, Europe, and others.

Closterium striolatum var. *rectum* W. WEST, Monogr. Br. Desm., **1**, p. 124, pl. 13, f. 17, 1904; KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 340, pl. 28. f. 13, 1935.

Cells 256–264μ long and 38–39μ broad. Pl. 1. fig. 5.

Hab. 16. Distr. Europe.

Closterium tumidum JOHNSON in W. & G. S. WEST, Monogr. Br. Desm., **1**, p. 156, pl. 19, f. 15–18, 1904; CROASDALE & GRÖNBLAD, Trans. Am. microsc. Soc., **83**, p. 159, pl. 2, f. 10–12, 1964.

Cells 110–119μ long and 11–12.3μ broad.

Hab. 43, 45, 203. Distr. Alaska, Canada, U.S.A., Novaya Semlya, Europe, and others.

Closterium venus KÜTZ. var. *incurvum* (BRÉB.) KRIEGER in Kryptogamenflora, **13**, Abt. 1, p. 273, pl. 16, f. 6, 7, 1935.

Cells 53–95μ long and 10–15.7μ broad.

Hab. 26, 28, 39, 64, 121, 160, 169. Distr. Cosmopolitan.

Pleurotaenium ehrenbergii (BRÉB.) de BARY in W. & G. S. WEST, Monogr. Br. Desm., **1**, p. 205, pl. 29, f. 9–11; pl. 30, f. 1, 1904; KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 410, pl. 42, f. 4–8, 1935.

Cells 317–396μ long, 26.5–36μ broad, and apices 17.6–26.5μ broad.

Hab. 58, 116. Distr. Alaska, Siberia, Novaya Zemlya, Europe, and others. Cosmopolitan species.

Pleurotaenium trabecula (EHRENB.) NÄG. in W. & G. S. WEST, Monogr. Br. Desm., **1**, p. 209, pl. 30, f. 11–13, 1904; KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 395, pl. 40, f. 1–4, 1935.

Cells 466–502μ long and 28.6–31.7μ broad. Pl. 2, fig. 10.

Hab. 116, 536. Distr. Alaska, Greenland, Novaya Zemlya, Europe, Japan, India, and Thailand.

Pleurotaenium trabecula var. *crassum* WITTR. in KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 399, Pl. 40, f. 6, 1935; CROASDALE, Farlowia. **4**, p. 528, pl. 10, f. 6, 1955.

Cells 273–352μ long and 40–60μ broad. Pl. 2, fig. 8, 9.

Hab. 115, 116. Distr. Alaska, Europe, Greenland, Novaya Zemlya, India, Central China, and Japan.

Pl. trabecula var. *elongatum* CEDERGREN in Kryptogamenflora, **13**, Abt. 1, p. 399, pl. 40, f. 5, 1935.

Cells 585-668μ long, 31–33μ broad. Pl. 2, fig. 11.

Hab. 117. Distr. Alaska and Europe.

Pleurotaenium truncatum (BRÉB.) NÄG. in W. & G. S. WEST, Monogr. Br. Desm., **1**, p. 203, pl. 29, f. 3, 4, 1904; KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 430, pl. 49, f. 2, 3, 1935.

Cells 308–458μ long, 42–61.5μ broad, and apices 20–26.5μ broad. Pl. 2, fig. 5.

Hab. 30, 33, 56, 74, 76, 104, 112. Distr. U.S.A., Europe, Alaska, Greenland, Novaya Zemlya, Spitzbergen, India, Japan, New Zealand, and S. America.

Pleurotaenium truncatum var. *crassum* BOLDT in W. & G. S. WEST, Monogr. Br. Desm., **1**, p. 204, 1904; KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 432, pl. 49, f. 7, 1935; CROASDALE, Farlowia, **4**, p. 529, pl. 9, f. 9, 10, 1955.

Cells 300–370μ long, 62–66μ broad, and apices 26.4–27μ broad. Pl. 2, fig. 6.

Hab. 74, 76. Distr. Alaska, Siberia, Novaya Zemlya, and Europe.

Tetmemorus laevis (KÜTZ.) RALFS in W. & G. S. WEST, Monogr. Br. Desm., **1**, p. 222, pl. 32, f. 11–16, 1904; KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 455, pl. 54, f. 9–12, 1937.

Cells 92.5–110μ long and 28.6–33μ broad.

Hab. 45 61, 65, 190. Distr. Alaska, U.S.A., Europe, Greenland, Novaya Zemlya, Australia, and New Zealand.

Cosmarium abbreviatum RACIB. var. *planctonicum* W. & G. S. WEST in Monogr. Br. Desm., **3**, p. 85, pl. 72, f. 13, 1908; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, **16** (3), p. 209, pl. 35, f. 8, 1956; CROASDALE, Trans. Am. microsc. Soc., **81**, p. 22, pl. 4, f. 55, 1962.

Cells 24–25μ long, 24–25μ broad, and isthmus 8μ broad. Pl. 5, fig. 22.

Hab. 104. Distr. Alaska, Devon Island, and Europe.

Cosmarium amoeviforme HIRANO, sp. nov.

Cellulae modicae, cylindricae, circiter $1^1/_2$ longiores quam latiores, levissime constrictae ad medium, sinu late excavato; semicellulae subsemiellipticae vel semicirculares, apice convexo; membrana granulata, granulis magnis, in serie horizontalibus dispositis, granulis in serie infimae geminatis; in vertice visae circulares, marginibus granulatis, granulis in serie radialibus dispositis. Long. 48–50μ, lat. 33–34μ, isth. 30.7–31μ lat. Pl. 8, fig. 7.

Hab. 94.

Similar forms to this species are already known from Burma, reported by JOSHUA under the name of *C. diadema* JOSHUA, but his species are larger than the present species and the vertical view of semicell is elliptic.

Cosmarium amoeviforme var. *angustatum* HIRANO, var. nov.

Cellulae angustiores quam in forma typica, apicibus semicellularum angusto-convexis; membrana granulata, granulis magnis in serie horizontalibus dispositis. Long. 50–52μ, lat. 28.5–29μ, isth. 27.3μ lat. Pl. 8, fig. 6.

Hab. 104.

Cosmarium anceps LUND. in W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 47, pl. 69, f. 14–17, 1908; GRÖNBLAD, Nova Hedwigia, **4**, pl. 101, f. 2, 1962; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, **18**(3), p. 203, pl. 33, f. 34; pl. 34, f. 1, 1963; FÖRSTER, Ark. Bot., ser. 2, **6**(3), p. 132, pl. 5, f. 18, 1965.

Cells 34–40μ long, 20–22μ broad, and isthmus 8.7–15μ broad. The specimens are similar to the British form reported by GRÖNBLAD but the cells are broader than his description. Pl. 5, fig. 17.

Hab. 15, 64, 148, 203, 223, 538. Distr. Alaska, Devon Island, Europe, Novaya Zemlya, Spitzbergen, Greenland, and Faeroes.

Cosmarium anceps forma *crispula* NORDST. in W. & G.S. WEST, Monogr. Br. Desm., **3**, p. 49, pl. 66, f. 17A, 1908; MESSIKOMMER, Beitr. geobot. Landesaufn. Schweiz, **24**, p. 149, pl. 6, f. 8; pl. 7, f. 2, 1942.

Cells 35–36μ long, 20–23μ broad, and isthmus 11–14μ broad. NORDSTEDT reported *Euastrum polare* (Öfv. K. Vet. Akad. Förh., 1872, no. 6, p. 37, pl. 7, f. 24) similar to this form but his species quite coincides with the present Alaskan form. The present form is distinguished from the typical form by having the undulated lateral margin. The present form resembles *C. pokornyanum* but the lower lateral margin is not divergent and retuse but rather convergent. Pl. 5, fig. 20–21.

Hab. 146. Distr. Europe and Novaya Zemlya.

C. anceps forma *subparvula* LARSEN, Meddr. Grönland, **33**(8), p. 326, pl. 7, f. 6, 1907; CROASDALE, Trans. Am. microsc. Soc., **75**, p. 14, pl. 8, f. 19, 1956; FÖRSTER, Ark. Bot., ser. 2, **6**(3), p. 133, pl. 5, f. 19, 22, 23; pl. 11, f. 1, 1965. — *Cosmarium parvulum* BRÉB. in WHELDEN, Bull. natn. Mus. Can., **97**, p. 84, pl. 5, f. 1, 1947. — *C. anceps* LUND. in SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, **18**(3), p. 203, pl. 34, f. 2, 1963.

Cells 26.4–28.6μ long, 15.4–17.6μ broad, and isthmus 12.3–15.4μ broad. Cells smaller than the typical form, sinus acuminate at the extremity but widely open outward. The present form differs from *C. parvulum* by having the basal inflation of lateral margin. Apex of semicell retuse, but some specimens from different places have a slightly convex apex. SKUJA explained all these forms obtained from North Europe unit as *C. anceps* itself. Sinus of typical form is somewhat deep and seems to be linear open, but other forms showing a sinus having a deep notch are reported from some parts of Europe and Canada. The present specimens coincide with the form reported by WHELDEN under another name. Pl. 5, fig. 8, 18, 19.

Hab. 146, 160, 223, 536. Distr. Alaska, Greenland, and Europe.

Cosmarium angulosum BRÉB. var. *concinnum* (RABENH.) W. & G. S. WEST in Monogr. Br. Desm., **3**, p. 94, pl. 72, f. 37, 38, 1908; CROASDALE, Trans. Am. microsc. Soc., **75**, p. 16, pl. 11, f. 16, 1956.

Hab. 121. Distr. Alaska, Europe, Greenland, Japan, India, Africa, Australia, and S. America.

Cosmarium arctoum NORDST. in Öfv. K. Vet.-Akad. Förh., p. 28, pl. 7, f. 22, 1875; W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 41, pl. 69, f. 2, 1908; GRÖNBLAD, Commentat. Biol., **5**(4), p. 3, f. 17–20, 1935; FÖRSTER, Ark. Bot., ser. 2, **6**(3), p. 133, pl. 4, f. 19, 1965.

Cells 17.6–23μ long, 13–17.5μ broad, and isthmus 11.4–13μ broad. Pl. 2, fig. 7.

Hab. 16, 43, 45, 55, 56, 76, 94, 104, 106, 190, 203. Distr. Spitzbergen, Greenland, Novaya Zemlya, Franz Joseph Land, and Europe.

Cosmarium biclavatum BORGE in Vid. Selsk. Skr. no. 11, p. 9, f. 7, 1911.

C. biclavatum var. *alaskanum* HIRANO, var. nov.

Cellulae minores quam in forma typica, leviter longiores quam latiores, modice constrictae ad medium, sinu excavato; semicellulae transverse ellipticae, marginibus lateralibus granulis quaternis ordinatis, apice truncato et glabro; membrana serie transalibus granulorum trans semicellulam, long. 22μ, lat. 18.5μ, lat. isth. 11μ, Pl. 6, fig. 6.

Hab. 45. The present variety is distinctly smaller than the typical form and the apex of semicell lacks granules. Also it differs from the typical form by the elliptic form of vertical view, instead of circular in the typical form.

Cosmarium binum NORDST. in W. & G. S. WEST, Monogr. Br. Desm.,**3**, p. 246, pl. 88, f. 10–14, 1908; CROASDALE, Trans. Am. microsc. Soc., **75**, p. 16, pl. 16, f. 5, 1956; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, **18**(3), p. 222, pl. 39, f. 7, 1963.

Cells 42–53μ long, 35–40μ broad, and isthmus 14–14.5μ broad.

Hab. 30, 40, 56, 57, 72, 173. Distr. Alaska, U.S.A., Europe, Japan, Sumatra, Central Africa, Australia, and Brazil.

Cosmarium bioculatum BRÉB. in W. & G. S. WEST, Monogr. Br. Desm., **2**, p. 165, pl. 61, f. 3–7, 1908; BORGE, Ark. Bot., **23A**(2), p. 35, pl. 2, f. 28, 1930; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, **18**(3), p. 195, pl. 33, f. 6, 1963.

C. bioculatum var. *borgei* HIRANO, var. nov.

Semicellulae late oblongo-rectangulares, marginibus lateralibus leviter convexis et verticalibus, apice paullo convexo; cellulis in vertice visis rhomboido-oblongis, polis bene rotundatis, long. 25–26μ, lat. 26.4–27μ, lat. isth. 6.5–6.8μ. Pl. 4, fig. 5.

The present specimens are somewhat different from the typical form by having the closed sinus and different shape of semicell.

C. bioculatum var. *depressum* SCHAARSCHM. in W. & G. S. WEST, Monogr. Br. Desm., **2**, p. 166, pl. 61, f. 8, 9, 1905; CROASDALE, Trans. Am. microsc. Soc., **84**, p. 316, pl. 3, f. 1–3, 1965.

Cells 22–26.5μ long, 24–26.5μ broad, and isthmus 8.4–8.8μ broad.

Hab. 65, 115, 513, 523. Distr. Alaska, Devon Island, Europe, and Japan.

Cosmarium biretum BRÉB. var. *minus* HANSG. in W. & G. S. WEST, Monogr. Br. Desm., **4**, p. 26, 1911.

Cells 44–45μ long, 23–24μ broad, and isthmus 11μ broad. Pl. 9, fig. 7.

Hab. 45. Distr. Europe.

Cosmarium blyttii WILLE in W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 225, pl. 86, f. 1–4, 1908; CROASDALE, Trans. Am. microsc. Soc., **75**, p. 18, pl. 14, f. 20, 1956.

Cells 15.4–16μ long, 15.4–16μ broad, and isthmus 4.4–5μ broad.

Hab. 121. Distr. Alaska, U.S.A., Europe, Greenland, Central China, Japan, and Africa.

Cosmarium boeckii WILLE in W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 234, pl. 86, f. 26–32, 1908; CROASDALE, Trans. Am. microsc. Soc., **75**, p. 20, pl. 15, f. 14, 1956; FÖRSTER, Ark. Bot., ser. 2, **6**(3), p. 134, pl. 7, f. 13, 1965.

Cells 35–44μ long, 31–36.5μ broad, and isthmus 10–11μ broad. The semicells of the present specimens are trapeziform-semicircular, lateral margin crenate, upper crenae distinct but the middle and lower crenae indistinct, apex 4-crenate and middle two crenae small and reduced; semicells furnished with a distinct series of granules within each crena, diminishing towards the centre; disposition of granules above the isthmus is not of a cruciate form. Pl. 1, fig. 3.

Hab. 94, 121. Distr. Alaska, U.S.A., Europe, Iceland, and Bornholm.

Cosmarium boergesenii GRÖNBLAD, Acta Soc. Sci. fenn., nov. ser. B, **2**(5), p. 36, pl. 2, f. 7, 1942; CROASDALE & GRÖNBLAD, Trans. Am. microsc. Soc., **83**, p. 174, pl. 12, f. 22, 23, 1964.

Cells 26.5–44μ long, 17.6–26.4μ broad, and isthmus 4.4–6.6μ broad. Lower lateral margin of semicells slightly divergent and retuse, upper lateral one is strongly convergent. Apex narrowly truncate or slightly convex. BORGE already reported a similar form from Africa and determined this form as *C. laeve*. The present Alaskan forms do not have retuse apex in semicell, so that I hesitate to agree with his determination. Pl. 4, fig. 10; Pl. 5, fig. 9.

Hab. 29, 56, 61, 74, 121. Distr. Alaska.

Cosmarium botrytis MENEGH. in W. & G. S. WEST, Monogr. Br. Desm., **4**, p. 1, pl. 96, f. 1, 2, 5–15, 1908; CROASDALE, Trans. Am. microsc. Soc., **75**, p. 20, pl. 17, f. 3, 1956.

Cells 71–88μ long, 57–70.5μ broad, and isthmus 17.6–27μ broad. Pl. 7, fig. 5.

Hab. 30, 36, 38, 45, 64, 72, 74, 115, 116, 117, 119, 121. Distr. Cosmopolitan.

Cosmarium botrytis var. *gemmiferum* (BRÉB.) NORDST. in W. & G. S. WEST, Monogr. Br. Desm.,**4** p. 5, pl. 97, f. 4, 1911; INSAM & KRIEGER, Hedwigia, **76**, p. 97, pl. 6, f. 11, 1936; MESSIKOMMER, Beitr. geobot. Landesaufn. Schweiz, **24**, p. 160, pl. 12, f. 1, 1942; CROASDALE, Trans. Am. microsc. Soc., **84**, p. 316, pl. 6, f. 1, 1965.

Cells 71–84μ long, 62–66μ broad, and isthmus 22μ broad. Pl. 9, fig. 2.

Hab. 40, 119, 538. Distr. Devon Island, Europe.

C. botrytis var. *mesoleium* NORDST. in BORGE, Ark. Bot., **28A**(6), p. 31, pl. 3, f. 47, 1936; INSAM & KRIEGER, Hedwigia, **76**, p. 97, pl. 6, f. 10, 1936.

Cells 57–66μ long, 46–57μ broad, and isthmus 17–17.6μ broad. Apex of semicell straight and destitute of granules; cell wall furnished with scrobiculations in the middle of semicell. Pl. 6, fig. 13.

Hab. 106. Distr. Europe.

C. botrytis var. *tumidum* WOLLE in W. & G. S. WEST, Monogr. Br. Desm., **4**, p. 5, pl. 97, f. 2, 3, 1911; CROASDALE, Trans. Am. microsc. Soc., **75**, p. 20, pl. 17, f. 7, 1956.

Cells 73–84μ long, 64–66μ broad, and isthmus 17.5–22μ broad. Granules in the centre of semicell are somewhat elongate and larger than the others. FÖRSTER reported a similar form from Lapland by the name of *C. tetraophthalmum* var. *crassiverrucosum*, but his form has a somewhat longer cell than the present specimens. This variety is distinguished from the typical form by larger granules arranged in the centre of the semicell or above the isthmus. Also the present form should be compared with *C. ochthodes* reported by KRIEGER from Spitzbergen. Pl. 9, fig. 1.

Hab. 29, 56, 58, 61, 65, 72, 74, 76, 119, 123. Distr. Alaska, U.S.A., and Europe.

Cosmarium canadense IRENÉE-MARIE, Flora Desm. Reg. Mont., p. 164, pl. 32, f. 3, 4, 1939.

Cells 70–71μ long, 63μ broad, and isthmus 35μ broad. Pl. 5, fig. 1.

Hab. 119. Distr. Canada.

Cosmarium connatum BRÉB. in W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 25, pl. 67, f. 15–17, 1908.

Hab. 115, 116, 123. Distr. Alaska, U.S.A., Europe, Japan, South-east Asia, Central Africa, and Brazil.

Cosmarium conspersum RALFS, Br. Desm., p. 101, pl. 16, f. 4, 1848; SKUJA, Nova Acta R. Soc. Scient. upsal. ser. 4, **18**(3), p. 211, pl. 37, f. 3, 1963.

Cells 97–101μ long, 70–71μ broad, and isthmus 26μ broad.

Hab. 115, 116. Distr. Alaska, Devon Island, U.S.A., Greenland, Novaya Zemlya, Europe, Bornholm, Iceland, and S. America.

C. conspersum var. *latum* (BRÉB.) W. & G. S. WEST in Monogr. Br. Desm., **4**, p. 15, pl. 99, f. 5, 6, 1911; INSAM & KRIEGER, Hedwigia, **76**, p. 98, pl. 5, f. 18, 1936.

Cells 88-90μ long, 72–73μ broad, and isthmus 20μ broad. Pl. 6, fig. 8.

Hab. 123. Distr. Alaska, U.S.A., Europe, Greenland, Faeroes, and Patagonia.

Cosmarium costatum NORDST., Öfv. K. Vet.-Akad. Förh., no. 6, p. 25, pl. 7, f. 17, 1875; W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 239, pl. 87, f. 13–16, 1908; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, **18**(3), p. 221, pl. 39, f. 4, 5, 1964; FÖRSTER, Ark. Bot., ser. 2, **6**(3), p. 135, pl. 7, f. 21, 22, 1965.

Cells 33–48.5μ long, 31–37.5μ broad, and isthmus 11–15.4μ broad. Semicells truncate-semicircular or subtrapeziform, lateral margin distinctly crenate, apex slightly crenate, each crenation emarginate and furnished with a pair of minute granules; in some specimens (especially in a collection of no. 57) crenation is quite entire so that cell

wall is furnished with radial series of granules or similar crenations just within each crenation, with a distinct vertical series of granulated ridges on the central tumour, each ridge with a distinct rounded granule just below it, outer ridges somewhat arcuate. Pl. 7, fig. 2.

Hab. 14, 15, 29, 30, 39, 56, 57, 64, 76, 94, 104, 115, 143. Distr. Alaska, Spitzbergen, Greenland, Novaya Zemlya, Europe, U.S.A., and Franz Joseph Land.

C. costatum forma *minor* BOLDT, Bih. K. Svenska Vet. Akad. Handl., **13**, Afd. 3, no. 5, p. 21, 1887; W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 240, 1908.

Cells 26.4-35μ long, 22-31μ broad, and isthmus 8.8-13μ broad. Semicells with three lateral crenae on each side, vertical ridges with a distinct series of isolated granules just below each ridge. Pl. 7, fig. 4.

Hab. 15, 16, 30, 40, 45, 55, 56, 59, 64, 65, 72, 74, 76, 94, 104, 112, 121, 123. Distr. Greenland and Europe.

C. costatum var. *subhexalobum* BOLDT in GRÖNBLAD, Comment. Biol., **5**(6), p. 9, pl. 2, f. 42, 1936.

Cell 41.3μ long, 40μ broad, and isthmus 15.4μ broad. Pl. 7, fig. 8.

Hab. 146. Distr. Greenland and Europe.

Cosmarium crenatum RALFS in W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 35, pl. 98, f. 9-12, 1908; GRÖNBLAD, Comment. Biol., **5**(4), p. 3, f. 13, 14, 1935; WHELDEN, Bull. natn. Mus. Can., **97**, p. 76, 1947; CROASDALE, Trans. Am. microsc. Soc., **81**, p. 26, pl. 4, f. 67-69, 1962; FÖRSTER, Ark. Bot., ser. 2, **6**(3), p. 135, pl. 8, f. 1, 2, 1965.

Cells 38.7-40μ long, 27.3-28μ broad, and isthmus 16.7-17μ broad. Lowermost crena in the lateral margin of semicells is retuse so that it seems to be two entire small crenae. Pl. 6, fig. 16.

Hab. 55, 148, 172. Distr. Alaska, U.S.A., Greenland, Spitzbergen, Siberia, Europe, Japan, Australia, and S. America.

C. crenatum var. *bicrenatum* NORDST., Öfv. K. Vet.-Akad. Förh., no. 6, p. 30, pl. 6, f. 10, 1872; INSAM & KRIEGER, Hedwigia, **76**, p. 98, pl. 4, f. 25, 1936; CROASDALE, Trans. Am. microsc. Soc., **81**, p. 26, pl. 4, f. 70-72, 1962; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, **18**(3), p. 219, pl. 37, f. 9, 1964.

Cells 26.4-27μ long, 17.6-22μ broad, and isthmus 8.8-10.6μ broad. Pl. 6, fig. 17.

Hab. 64, 160, 223. Distr. Alaska, Spitzbergen, and Europe.

C. crenatum var. *boldtianum* (GUTW.) W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 37, pl. 98, f. 13, 14, 1908; WHELDEN, Bull. natn. Mus. Can., **97**, p. 76. 1947.

Cells 44-45μ long, 31.7-32μ broad, and isthmus 22μ broad.

Hab. 148. Distr. Canada, Europe, and Sumatra.

Cosmarium cruciferum DE BARY, Conj., p. 72, pl. 7G, f. 3-6, 1858; KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 241, 1935.—*Penium cruciferum* (DE BARY) WITTR. in W. & G. S. WEST, Monogr. Br. Desm., **1**, p. 100, pl. 10, f. 18, 19, 1904.

Cells 22-24μ long, 13-14μ broad, and isthmus 13μ broad.

Hab. 169, 190. Distr. U.S.A., Europe, New Zealand and East Africa.

Cosmarium cucumis CORDA in W. & G. S. WEST, Monogr. Br. Desm., **2**, p. 152, pl. 59, f. 18-20, 1905; WHELDEN, Bull. natn. Mus. Can., **97**, p. 229, 1947; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, **18**(3), p. 189, pl. 32, f. 1, 1964.

Cells 86-92μ long, 53-57μ broad, and isthmus 30.7-31μ broad. Pl. 4. fig. 14.

Hab. 45, 55. Distr. Alaska, Canada, Greenland, Spitzbergen, Novaya Zemlya, Europe, Siberia, and S. America.

Cosmarium cucurbita BRÉB. var. *attenuatum* G. S. WEST, Monogr. Br. Desm., **2**, p. 108, pl. 73, f. 34-36, 1908; FÖRSTER, Ark. Bot., ser. 2, **6**(3), p. 135, pl. 3, f. 6, 1965.

Cells 31-37.4μ long, 13-16.7μ broad, and isthmus 12.8-16μ broad. The length of cells of present specimens is 2.4 times their breadth, apex subtruncate. *Cosmarium adelochondrum* is similar to this variety but the cells are shorter than the present specimens.

Hab. 16, 55, 72, 169, 193, 203, 205, 223, 516. Distr. Devon Island, Europe, and W. Indies.

Cosmarium cucurbitinum (BISS.) LÜTKEM. forma *minor* (WEST) LÜTKEM. in GRÖNBLAD, Memo. Soc. Fauna. Flora. fenn., **10**, p. 267, pl. 4, f. 4, 5, 1934; HIRANO, Contr. Biol. Lab. Kyoto Univ., **1**, p. 80, pl. 16, f. 8, 1956.

Cells 44-55μ long, 22-26.4μ broad, and isthmus 20-25μ broad. Pl. 3, fig. 7.

Hab. 22, 45, 65, 76, 148, 160, 173, 203, 223. Distr. Europe and Japan.

Cosmarium curtum (BRÉB.) RALFS in WEST & CARTER, Monogr. Br. Desm., **5**, p. 267, 1923; INSAM & KRIEGER, Hedwigia, **76**, p. 99, pl. 1, f. 25, 26, 1936.

Cells 51-53μ long, 24-26.4μ broad, and isthmus 22-25μ broad. Semicells somewhat variable, some specimens are conical, but others are short subcylindrical with attenuated side and rounded apex. Pl. 4, fig. 15.

Hab. 15, 172, 173. Distr. Devon Island, Spitzbergen, Europe, and Japan.

C. curtum var. *obtusum* (W. & G. S. WEST) HIRANO. comb. nov.

Penium curtum BRÉB. var. *obtusum* W. & G. S. WEST in J. Bot., **38**, p. 289, pl. 412, f. 1, 2, 1900; Monogr. Br. Desm., **1**, p. 99, pl. 10, f. 26, 1904.

Cells 48.4-50μ long, 24-26μ broad, and isthmus 22-24μ broad. Pl. 5, fig. 4.

Hab. 64, 172. Distr. Europe.

Cosmarium cyclicum LUND. var. *arcticum* NORDST., Öfv. K. Vetensk-Akad. Förh.,

no. 6, p. 31, pl. 6, f. 13, 1872; W. & G. S. WEST, Monogr. Br. Desm., **2**, p. 146, pl. 58, f. 10, 1905; WHELDEN, Bull. natn. Mus. Can., **97**, p. 77, pl. 5, f. 7, 1947; CROASDALE, Trans. Am. microsc. Soc., **81**, p. 26, pl. 5, f. 73, 1962.

Cells 70.4–75μ long, 74–75μ broad, and isthmus 19–25μ broad. Cells hexagono-circular, apex 4 crenate, crenae in some specimens slight but deep in others; granules on and within the margin of each crena are in pairs. Vertical view of semicell rhomboidal and centre of it smooth. Pl. 8, fig. 9.

Hab. 22, 55, 57, 58, 61, 76, 158, 203, 223. Distr. Alaska, Devon Island, Greenland, Spitzbergen, Novaya Zemlya, Europe, Faeroes, Bornholm, and Japan.

Cosmarium cymatonotophorum WEST, Monogr. Br. Desm., **3**, p. 40, pl. 68, f. 37–39, 1908; INSAM & KRIEGER, Hedwigia, **76**, p. 99, pl. 4, f. 13, 1936.

Cell 10μ long, 8.8μ broad, and isthmus 4.4μ broad. Pl. 4, fig. 8.

Hab. 56. Distr. Europe.

Cosmarium debaryi ARCH. in W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 61, pl. 70, f. 14–16; pl. 93, f. 2, 1908; IRENÉE-MARIE, Bull-natn. Mus. Can., **82**, p. 132, f. 4, 1955; CROASDALE, Trans. Am. microsc. Soc., **84**, p. 318, pl. 4, f. 6, 7, 1965.

Cells 105–108μ long, 48–49μ broad, and isthmus 35–36μ broad.

Hab. 56. Distr. Alaska, U.S.A., Devon Island, Novaya Zemlya, Spitzbergen, Europe, Bornholm, and Brazil.

C. debaryi var. *novae-semliae* WILLE, Öfv. K. Vet.-Akad. Förh., no. 5, p. 48, pl. 13, f. 47, 1879; FÖRSTER, Ark. Bot., ser. 2, **6**(3), p. 136, pl. 4, f. 2, 1965.

Cells 102–107μ long, 49.3–55μ broad, and isthmus 31.7–36μ broad. Pl. 3, fig. 16.

Hab. 76. Distr. Novaya Zemlya and N. Europe.

Cosmarium decedens (REINSCH) RACIB. var. *borgei* KRIEGER, Ber. dt. bot. Ges., **56**, p. 61, pl. 1, f. 18, 1938.

Cells 39–40μ long, 22–22.5μ broad, and isthmus 13μ broad. The present forms coincide with the forms known from Spitzbergen by having slight undulations on the lateral margin. Pl. 4, fig. 1.

Hab. 64. Distr. Spitzbergen.

Cosmarium depressum (NÄG.) LUND. in W. & G. S. WEST, Monogr. Br. Desm., **2**, p. 176, pl. 62, f. 2–5, 1905; SKUJA, Nova Acta R. Soc. Scient. upsal. ser. 4, **18**(3), p. 196, pl. 33, f. 1, 1963.

Cells 37.4–55μ long, 35–53μ broad, and isthmus 13–14μ broad.

Hab. 56, 61, 74, 76, 93, 115, 117, 119, 123. Distr. Alaska, U.S.A., Greenland, Europe, India, Ceylon, Burma, Japan, and Australia.

C. depressum var. *planctonicum* REV. in SKUJA Nova Acta R. Soc. Scient. upsal. ser.

4, **18**(3), p. 196, pl. 33, f. 2, 3, 1964.

Cells 28–29μ long, 29,5–30μ broad, and isthmus 6.6–7μ broad. Pl. 6, fig. 7.

Hab. 110. Distr. N. Europe.

Cosmarium difficile LÜTKEM. in W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 96, pl. 73, f. 1–3, 1908; GRÖNBLAD, Nova Hedwigia, **4**, pl. 101, f. 3, 1962; SKUJA. Nova Acta R. Soc. Scient. upsal., ser. 4, **18**(3), p. 208, pl. 35, f. 29; pl. 36, f. 7, 8, 1963.

Cells 35–42μ long, 22–28.6μ broad, and isthmus 8–10.6μ broad. BORGE reported a similar form as *C. meneghinii* from Sweden, but his form is smaller. Lower lateral margins of *C. meneghinii* are vertical and the apex of semicell is retuse. The determination to his form is questionable. The transverse series of punctations are sometimes indistinct. Pl. 3, fig. 2.

Hab. 65, 115. Distr. U.S.A. and Europe.

C. difficile var. *sublaeve* LÜTKEM. in CROASDALE, Trans. Am. microsc. Soc., **75**, p. 28, pl. 11, f. 11, 18, 1956.

Cell 35μ long, 23μ broad, and isthmus 8.7μ broad. Pl. 4, fig. 3.

Hab. 123. Distr. Alaska and Canada.

Cosmarium diplosporum (LUND.) LÜTKEM. var. *americanum* (W. & G. S. WEST) HIRANO, comb. nov.

Cylindrocystis americana W. & G. S. WEST, J. Linn. Soc., Bot., **33**, p. 281, pl. 18, f. 5, 6, 1898.

Cells 77–81.4μ long, 35–39.6μ broad. The present specimens correspond to the intermediate size between the typical form and var. *maius* W. WEST. Pl. 3, fig. 15.

Hab. 117, 123. Distr. U.S.A.

Cosmarium formosulum HOFF. in W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 240, pl. 88, f. 1–3, 1908; CROASDALE, Trans. Am. microsc. Soc., **75**, p. 32, pl. 16, f. 1, 1956.

Cells 45–57μ long, 39–48μ broad, and isthmus 13–17.5μ broad. Semicells subtrapeziform, basal part somewhat dilated upward, therefore lowermost lateral margin slightly divergent and then convex convergent, lateral margin 7-crenate, apex rather narrow and slightly 4-crenate. Pl. 9, fig. 6.

Hab. 44, 94. Distr. Alaska, Canada, Iceland, Faeroes, Bornholm, and Europe.

Cosmarium furcatospermum W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 206, pl. 81, f. 10–11; pl. 84, f. 8–10, 1908; CROASDALE, Trans. Am. microsc. Soc., **75**, p. 34, pl. 14, f. 14, 15, 1956.

Cells 22–24μ long, 21–22μ broad, and isthmus 8μ broad.

Hab. 16. Distr. Alaska, Europe, Canada, and Japan.

Cosmarium globosum BULNH. in W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 29, pl.

68, f. 1, 2, 1908; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, **18**(3), p. 190, pl. 29, f. 19, 1964.

Cells 31–32μ long, 21–21.5μ broad, and isthmus 19.7–20μ broad.

Hab. 15, 169. Distr. Europe, Novaya Zemlya, Spitzbergen, U.S.A., Greenland, Japan, E. Africa, and S. America.

Cosmarium granatum BRÉB. in W. & G. S. WEST, Monogr. Br. Desm., **2**, p. 186, pl. 63, f. 1–3, 1908; CROASDALE, Trans. Am. microsc. Soc., **75**, p. 34, pl. 6, f. 11, 12, 1956; SKUJA, Nova Acta R. Soc. Scient. upsal. ser. 4, **18**(3), p. 198, pl. 33, f. 16–18, 20, 1964.

Cells 40–48μ long, 25.5–31μ broad, and isthmus 7.5–8.8μ broad. Pl. 5, fig. 6.

Hab. 30, 43, 55, 56, 57, 58, 59, 64, 76, 106, 115, 119, 123, 538. Distr. Canada, U.S.A., Greenland, Spitzbergen, Iceland, Faeroes, Siberia, Europe, Novaya Zemlya, Japan, India, Ceylon, and S. America.

C. granatum var. *concavum* LAGERH. in W. & G. S. WEST, Monogr. Br. Desm., **2**, p. 188, 1905.

Cell 37.4μ long, 26.4μ broad, and isthmus 6.6μ broad. Semicells of *C. granatum* variable in form, and the majority of specimens coincide with the typical form of species. In some specimens upper lateral margin of semicell is retuse and this corresponds to var. *concavum* LAGERH. WEST did not give a special name to such a variation. Such a form apparently resembles *C. hammeri*, but is distinguished from the latter by the smaller size. Apex always convex and narrow in general, but in some specimens not so narrow as those of the typical form. Pl. 5, fig. 14.

Hab. 121. Distr. Ecuador.

C. granatum var. *elongatum* NORDST. in W. & G. S. WEST, Monogr. Br. Desm., **2**, p. 189, pl. 63, f. 10, 1905; MESSIKOMMER, Vjschr. naturf. Ges. Zürich, **80**, p. 46, pl. 2, f.20, 1935; CROASDALE, Trans. Am. microsc. Soc., **75**, p. 36, pl. 6, f. 14, 15, 1956.

Cells 56–62μ long, 29–30μ broad, and isthmus 15–16.5μ broad. Pl. 5, fig. 3.

Hab. 160. Distr. Alaska, Greenland, Spitzbergen, Europe, and Afghanistan.

C. granatum var. *subgranatum* NORDST. in W. & G. S. WEST, Monogr. Br. Desm., **2**, p. 188, pl. 63, f. 5–8, 1905; CROASDALE, Trans. Am. microsc. Soc., **75**, p. 36, pl. 6, f. 14, 15, 1956.

Cells 31–33μ long, 24–25.5μ broad, and isthmus 8–8.8μ broad. The undulation of upper part of lateral margin seems to be variable, biundulate in normal type, but sometimes shows a tendency to triundulate in some individuals, lowermost part of lateral margin is vertical and retuse, and in these respects the present forms coincide with the explanation by CROASDALE. In European forms the lowermost lateral margin is slightly divergent. The apex of the present forms is slightly broader than the European description. Pl. 5, fig. 5.

Hab. 117, 119, 123. Distr. Alaska, U.S.A., Europe, Japan, New Zealand, and S. America.

Cosmarium hammeri REINSCH var. *homalodermum* (NORDST.) W. & G. S. WEST, Monogr. Br. Desm., **2**, p. 182, pl. 62, f. 22, 1905; CROASDALE, Trans. Am. microsc. Soc., **75**, p. 36, pl. 6, f. 8, 1956; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, **18**(3), p. 198, pl. 33, f. 12, 1964.

Cells 57–70μ long, 48.5–61.6μ broad, and isthmus 15.4–17.6μ broad. Pl. 3, fig. 9.

Hab. 16, 22, 169, 193, 223, 513, 538. Distr. Alaska, Europe, Greenland, Spitzbergen, Novaya Zemlya, Faeroes, Japan, and India.

Cosmarium hexalobum NORDST. var. *laticeps* GRÖNBLAD, Acta Soc. Scient. fenn., n.s. B, **2**(5), p. 37, pl. 2, f. 47, 1942.

Cells 59–60μ long, 41.5–42μ broad, and isthmus 15–15.7μ broad. The present forms resemble *C. subhieronymusii* which WHELDEN reported from Arctic Canada. Pl. 8, fig. 3.

Hab. 169. Distr. Europe.

Cosmarium hians BORGE, Bot. Notiser, p. 13, pl. 1, f. 6, 1913.

Cells 22μ long, 20μ broad, and isthmus 11μ broad. SKUJA reported *C. wittrockii* var. *quasidepressum* from Lapland, Sweden resembling this species in form and in its size of cell, but semicells are broader than the typical form and the apex broad and straight, sinus almost rectangularly open. The number of horizontal series of granules on the face of semicell is much more than five series of his form of *C. wittrockii*. Pl. 8, fig. 2.

Hab. 123. Distr. Europe.

Cosmarium holmiense LUND. var. *integrum* LUND. in W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 2, pl. 65, f. 3–5, 1908; CROASDALE, Trans. Am. microsc. Soc., **75**, p. 38, pl. 7, f. 12, 1956; SKUJA, Nova Acta R. Soc. Scient. upsal. ser. 4, **18**(3), p. 201, pl. 35, f. 21, 1964.

Cells 50.6–64μ long, 31–39.6μ broad, and isthmus 17.6–20.7μ broad. Pl. 5, fig. 7.

Hab. 64, 72, 143, 146, 148, 160, 172, 173, 190, 223, 523. Distr. Alaska, Canada, Devon Island, Europe, Spitzbergen, Novaya Zemlya, Faeroes, and U.S.A.

Cosmarium hornavanense GUTW. in DEFLANDRE, Bull. Soc. bot. Fr., **75**, f. 4 in p. 1009, 1928; INSAM & KRIEGER, Hedwigia, **76**, p. 101, pl. 6, f. 1, 1936; RUZICKA, Prirodov. Sb. ostrav. Kraje, **17**, p. 44, pl. 3, f. 24, 25, 1956; MESSIKOMMER, Nova Hedwigia, **4**, p. 162, f. 6, 1962.

Cells 71–100μ long, 57–77μ broad, and isthmus 17.6–26.4μ broad. Pl. 9, fig. 10.

Hab. 45, 57, 72, 94, 106, 116, 123, 172, 513. Distr. Europe.

C. hornavanense forma *arcticum* CROASDALE in Trans. Am. microsc. Soc., **84**, p. 320,

pl. 6, f. 3, 4, 1965.

Cells 88–94.6μ long. 66–72.6μ broad, and isthmus 22μ broad. The specimens resemble the form of var. *dubovianum* reported by FÖRSTER from Swedish Lapland. Pl. 9, fig. 5.

Hab. 55, 74, 536. Distr. Devon Island.

C. hornavanense var. *dubovianum* (LÜTKEM.) RUZ. in FÖRSTER, Ark. Bot., ser. 2, **6**(3), p. 140, pl. 6, f. 13, 14, 1965; MESSIKOMMER, Schweiz. Z. Hydrol. **27**, p. 152, f. 11, 1965. — *C. dubovianum* LÜTKEM. in Verh. zool.-bot. Ges. Wien, p. 487, pl. 2, f. 14–16, 1910.

Cells 57–88μ long, 53–64μ broad, and isthmus 15.4–22μ broad. Cells with a transverse series of granules just above the isthmus and with a smooth space in the middle of semicell. Pl. 1, fig. 4.

Hab. 30, 523, 536. Distr. Alaska and Europe.

Cosmarium humile (GAY) NORDST. var. *striatum* (BOLDT) SCHMIDLE, Öst. bot. Z., no. 7, p. 389, 1895; W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 223, pl. 85, f. 21, 22, 1908.

Cells 15.4–23.3μ long, 15.4–23.3μ broad, and isthmus 5.3–8.8μ broad. Lower lateral margin of semicell slightly divergent and retuse, apical angles obliquely truncate and emarginate, apex minutely 4-undulate. Cell wall furnished with two series of minute granules within the margin and 3 elongate granules horizontally disposed above the isthmus. Pl. 4, fig. 7.

Hab. 56, 116, 117. Distr. Alaska, U.S.A., Siberia, Europe, Faeroes, Japan, Malaya, and Patagonia.

Cosmarium impressulum ELFV. in W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 86, pl. 72, f. 14–18, 1908; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, **18**(3), p. 194, pl. 32, f. 17–19, 1964.

Cells 24–31.7μ long, 17.6–24μ broad, and isthmus 5.7–8μ broad. The whole margin of semicell with 7 undulations and three on each side, sometimes undulation is not distinct and the outline of semicell resembles *C. granatum* var. *subgranatum* which has a narrow apex. Pl. 4, fig. 12.

Hab. 116, 117. Distr. U.S.A., Siberia, Greenland, Europe, Japan, India, New Zealand, Australia, and S. America.

Cosmarium incertum SCHMIDLE var. *groenlandicum* (BOLDT) GUTW. in CROASDALE, Trans. Am. microsc. Soc., **75**, p. 40, pl. 11, f. 15, 1956; FÖRSTER, Ark. Bot., ser. 2, **6**(3), p. 141, pl. 5, f. 27, 1965.

Cells 35–39.6μ long, 22μ broad, and isthmus 6.6–7.5μ broad. Pl. 4, fig. 22.

Hab. 116, 117, 123. Distr. Alaska, Europe, and Greenland.

Cosmarium isthmochondrum NORDST. var. *decussiferum* (BORGE) CROASDALE in Trans.

Am. microsc. Soc., **75**, p. 40, pl. 14, f. 7–10, 1956.—*C. decussiferum* BORGE, Ark. Bot., **6**, p. 33, pl. 2, f. 18, 1906.

Cells 37–39μ long, 27–28μ broad, and isthmus 15–16μ broad. Pl. 6, fig. 2.

Hab. 172. Distr. Alaska and Europe.

Cosmarium kjellmanii WILLE var. *grande* WILLE, Öfv. K. Vet.-Akad. Förh., no. 5, p. 43, pl. 12, f. 33, 1879; W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 221, pl. 85, f. 15, 1908.

Cells 46–48.4μ long, 43–44μ broad, and isthmus 14.7–15.4μ broad. Semicells truncate-semicircular, lateral margin convex and converging upward, furnished with 8–9 granules, apex truncate and 6-undulate, apical angle somewhat emarginate or with a single granule; cell wall with a prominent series of granules above the isthmus which are vertically disposed. Pl. 6, fig. 10.

Hab. 116. Distr. Greenland, Novaya Zemlya, and Siberia.

Cosmarium latifrons LUND. in W. & G. S. WEST, Monogr. Br. Desm., **4**, p. 33, pl. 94, f. 6, 1911.

Cells 39.5–41.8μ long, 41.5–44μ broad, and isthmus 13–15.4μ broad. Pl. 8, fig. 1.

Hab. 36, 76, 94, 112. Distr. Europe and Siberia.

Cosmarium margaritatum (LUND.) ROY & BISS. in W. & G. S. WEST, Monogr. Br. Desm., **4**, p. 18, pl. 99, f. 8, 10, 1911; SKUJA, Nova Acta R. Soc. Scient. upsal. ser. 4, **18** (3), p. 211, pl. 37, f. 4–6, 1964.

Cells 70.4–88μ long, 57–75μ broad, and isthmus 17.6–26.4μ broad.

Hab. 30, 55, 64, 115, 116, 117, 123. Distr. Alaska, Canada, U.S.A., Greenland, Europe, Japan, Ceylon, Malaya, and Africa.

C. margaritatum forma *minor* (BOLDT) W. & G. S. WEST, Monogr. Br. Desm., **4**, p. 19, pl. 99, f. 9, 1911; CROASDALE, Trans. Am. microsc. Soc.,**75**, p. 41, pl. 16, f. 11, 1956.

Cells 53–54μ long, 44–45μ broad, and isthmus 13–13.5μ broad.

Hab. 112. Distr. Alaska, Europe, Japan, Greenland, and Africa.

C. margaritatum var. *rotundatum* HIRANO, var. nov.

Cellulae submagnae, leviter longiores quam latiores, profunde constrictae ad medium, sinu sublineari aperto et rotundato ad apicem; semicellulae aliquantum ellipticosubrectangulares, angulis basalibus et apicalibus late rotundatis, marginibus lateralibus convexis aliquando marginibus lateralibus inferioribus divergentibus, marginibus lateralibus aliquando convexo-convergentibus ad apicem; membrana distincte granulata, granulis in serie obliqualiter dispositis, inter granulos distincte punctata. Cellulae 101–106μ longae, 79–88μ latae, 32–35μ lat. isth. Pl. 7, fig. 1.

Hab. 28, 65, 538.

Cosmarium margaritiferum MENEGH. in W. & G. S. WEST, Monogr. Br. Desm.,**3**, p.

199, pl. 83, f. 4–11, 1908; CROASDALE & GRÖNBLAD, Trans. Am. microsc. Soc., **83**, p. 182, pl. 14, f. 8–11, 1964.

Cells 47–53μ long, 37.4–48.5μ broad, and isthmus 14–15.4μ broad.

Hab. 16, 26, 45, 55, 115, 117, 123. Distr. Alaska, Canada, U.S.A., Siberia, Greenland, Iceland, Europe, Japan, and Brazil.

Cosmarium microsphinctum NORDST. in W. & G. S. WEST, Monogr. Br. Desm., **2**, p. 156, pl. 60, f. 5–8, 1905; KRIEGER, Ber. dt. bot. Ges., **56**, p. 62, pl. 1, f. 27, 1938; CROASDALE, Trans. Am. microsc. Soc., **75**, p. 42, pl. 4, f. 4, 1956; SKUYA, Nova Acta R. Soc. Scient. upsal., ser. 4, **18**(3), p. 192, pl. 31, f. 10–12, 1964.

Cells 41–48μ long, 30–35μ broad, and isthmus 14–20.7μ broad. Pl. 3, fig. 10.

Hab. 56, 59, 72, 146, 158, 160, 169, 172, 173, 223. Distr. Alaska, U.S.A., Spitzbergen, Greenland, Novaya Zemlya, Franz Joseph Land, Europe, Iceland, and Japan.

Cosmarium nasutum NORDST., Öfv. K. Vet.-Akad. Förh., no. 6, p. 33, pl. 7, f. 17, 18, 1872; W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 259, pl. 90, f. 9, 10, 1908.

Cells 48.4–52.8μ long, 37–39.6μ broad, and isthmus 12.3–16μ broad.

Hab. 76, 94. Distr. Alaska, Canada, U.S.A., Europe, Greenland, Spitzbergen, and Japan.

Cosmarium ochthodes NORDST. in W. & G. S. WEST, Monogr. Br. Desm., **4**, p. 10, pl. 98, f. 1–3, 1911.

Cells 115–118μ long, 80–82μ broad, and isthmus 23–24μ broad.

Hab. 55. Distr. Alaska, U.S.A., Europe, Greenland, Spitzbergen, Novaya Zemlya, and Japan.

C. ochthodes var. *amoebum* WEST in W. & G. S. WEST, Monogr. Br. Desm., **4**, p. 11, pl. 98, f. 4–6, 1911; CROASDALE, Trans. Am. microsc. Soc., **75**, p. 43, pl. 17, f. 13, 14, 1956.

Cells 97–106μ long, 69.5–72.6μ broad, and isthmus 24–26.4μ broad. Semicells rather semicircular, not truncate-pyramidate, broader than those of the typical form.

Hab. 14, 16, 22, 28, 30, 33, 40, 45, 55, 59, 65, 72, 76, 104, 105, 112, 119. Distr. Alaska, Spitzbergen, and Europe.

Cosmarium pachydermum LUND. in W. & G. S. WEST, Monogr. Br. Desm., **2**, p. 139, pl. 57, f. 7, 1905.

C. pachydermum var. *alaskense* HIRANO, var. nov.

Semicellulae late depresso-ovatae, sinu leviter angusto-lineari ad apicem sed interdum in extrorsum leviter acutangulo. Cellulae 105–106μ longae, 83–84μ latae, 48μ lat. isth. Pl. 4, fig. 21.

Hab. 115. The present specimens coincide well with the Alaskan form reported by CROASDALE. This variety differs from the typical form by having a more depressed

semicell.

Cosmarium phaseolus BRÉB. var. *achondrum* BOLDT, Öfv. K. Vet.-Akad. Förh., no. 2, p. 103, pl. 5, f. 7, 1885; CROASDALE, Trans. Am. microsc. Soc., **75**, p. 45, pl. 4, f. 9, 10, 1956.

Cells 35-37μ long, 33-34μ broad, and isthmus 10.5-11μ broad. Pl. 4, fig. 20.

Hab. 116. Distr. Alaska and Siberia.

C. phaseolus var. *elevatum* NORDST. in W. & G. S. WEST, Monogr. Br. Desm., **2**, p. 159, pl. 60, f. 16, 17, 1905; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, **18**(3), p. 195, pl. 33, f. 4, 5, 1964; CROASDALE, Trans. Am. microsc. Soc., **84**, p. 322, pl. 2, f. 15, 16, 1965.

Cells 28.5-39μ long, 31-35μ broad, and isthmus 8.8-13μ broad. Semicells low truncate-pyramidate; cell wall punctate-scrobiculate, sinus narrowly linear but in some specimens acutely open, papilla of central part of semicell is distinctly visible. Pl. 3, fig. 3; Pl. 4, fig. 18.

Hab. 29, 30, 55, 56, 58, 59, 61, 119. Distr. Alaska, Canada, Devon Island, Europe, Spitzbergen, Iceland, Faeroes, and Japan.

Cosmarium pokornyanum (GRUN.) W. & G. S. WEST, Monogr. Br. Desm., **2**, p. 190, pl. 63, f. 11-15, 1905; KRIEGER, Ber. dt. bot. Ges., **56**, p. 62, pl. 1, f. 26, 1938; SKUYA, Nova Acta R. Soc. Scient. upsal., ser. 4, **18**(3), p. 199, pl. 33, f. 26-28, 1964.

Cells 33-41μ long, 20-26μ broad, and isthmus 9-15μ broad. There are two different forms in the present collections: lower lateral margin of semicell is divergent in some specimens, and almost vertical in others. The present Alaskan forms coincide with the figure given by KRIEGER from Spitzbergen. Pl. 3, fig. 1.

Hab. 64, 72, 173. Distr. Alaska, Devon Island, U.S.A., Europe, Greenland, Spitzbergen, Novaya Zemlya, and Japan.

Cosmarium portianum ARCH. in W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 165, pl. 80, f. 4-7, 1908; CROASDALE, Trans. Am. microsc. Soc., **75**, p. 46, pl. 12, f. 6, 7, 1956.

Cells 38-40μ long, 28-32μ broad, and isthmus 11-13μ broad.

Hab. 117, 123. Distr. Alaska, Canada, U.S.A., Europe, Spitzbergen, Novaya Zemlya, Siberia, and Japan. Probably cosmopolitan.

Cosmarium praemorsum BRÉB. in W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 196, pl. 84, f. 1-5, 1908; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, **18**(3), p. 217, pl. 38, f. 1, 2, 1964; CROASDALE & GRÖNBLAD, Trans. Am. microsc. Soc., **83**, p. 183, pl. 14, f. 7, 1964.

Cells 44-51μ long, 42-44μ broad, and isthmus 13-16μ broad. There are two different forms among the collections from various places: semicells in some specimens truncate-subsemicircular and trapeziform in others, apex truncate or slightly convex,

granules distinct and rounded. The species is similar to *C. punctulatum*, but is distinguished from it by the smaller size, the nature of granules, and by the sparse arrangement of granules on the face of semicell. Pl. 9, fig. 4.

Hab. 38, 55, 64, 76, 536, 538. Distr. Canada, Europe, and E. Africa.

Cosmarium protractum (NÄG.) DE BARY in W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 181, pl. 94, f. 4, 5, 1908; CROASDALE, Trans. Am. microsc. Soc., **75**, p. 46, pl. 12, f. 8, 1956.

Cells 42–44μ long, 40–42μ broad, and isthmus 10.5–12.5μ broad.

Hab. 74, 115, 116, 117. Distr. Alaska, U.S.A., and Europe.

Cosmarium protumidum NORDST. in Öfv. K. Vet.-Akad. Förh., no. 6, p. 34, pl. 7, f. 18, 1872; KRIEGER, Ber. dt. bot. Ges., **56**, p. 62, pl. 1, f. 21–23, 1938; GRÖNBLAD, Acta Soc. Sci. fenn., n. ser. B, **2**(5), p. 39, pl. 3, f. 4, 1942.

Cells 40–42μ long, 31–35μ broad, and isthmus 11–13μ broad. Pl. 6, fig. 4, 9.

Hab. 64, 169. Distr. Alaska, Spitzbergen, and Europe.

Cosmarium pseudonitidulum NORDST. var. *validum* W. & G. S. WEST, Monogr. Br. Desm., **2**, p. 196, pl. 63, f. 27–30, 1905; CROASDALE, Trans. Am. microsc. Soc., **84**, p. 323, pl. 4, f. 2, 3, 1965.

Cells 62–63μ long, 40–46μ broad, and isthmus 13–17μ broad. The specimens resemble those from Devon Island reported by CROASDALE. Pl. 4, fig. 16.

Hab. 76, 115. Distr. Canada, Devon Island, Europe, Japan, India, Malaya and W. Africa.

Cosmarium pseudoprotuberans KIRCHN. forma *minus* KOSSINSKAYA in CROASDALE, Trans. Am. microsc. Soc., **75**, p. 47, pl. 10, f. 5, 1956; *l. c.*, **84**, p. 323, pl. 3, f. 23–25, 1965.

Cells 20–26μ long, 19–22μ broad, and isthmus 6–9μ broad. Semicells slightly reniform-hexagonal, lower lateral margin slightly longer than upper one, sinus sublinearly open. The specimens coincide well with the forms reported previously by CROASDALE. Pl. 5, fig. 10–13, 16.

Hab. 26, 29, 36, 39, 43, 44, 61, 65, 94. Distr. Devon Island, Alaska, and Siberia.

C. pseudoprotuberans var. *alpinum* RACIB. in W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 83, pl. 91, f. 10, 1908; BORGE, Ark. Bot., **28**A(6), p. 36, pl. 1, f. 23, 1936.

Cells 15–17.6μ long, 12–13μ broad, and isthmus 3.5–4μ broad. Semicells with convex apex and broadly rounded apical angles, lateral margin convex and divergent, sinus closed. The specimens somewhat smaller than the dimension of European forms given by BORGE from North Europe. Pl. 5, fig. 15.

Hab. 44. Distr. Europe.

C. pseudoprotuberans var. *angustius* NORDST., Bih. K. Svenska. Vet.-Akad. Handl., **22**(8), p. 58, pl. 6, f. 15, 16, 1888; CROASDALE, Trans. Am. microsc. Soc., **75**, p. 47, pl. 10, f. 6, 1956.

Cells 30–31μ long, 24μ broad, and isthmus 7.8–8μ broad. The present specimens are somewhat smaller than those of the original description, but coincide with them in other respects. Lower lateral margin of the Alaskan forms is convex, while straight or sometimes retuse on the form reported from New Zealand. Apex very narrow and scarcely flattened. The plants on the present specimens are similar to *C. scopulorum* in outline of semicell, but larger. INSAM & KRIEGER described var. *borgei* from Tirol as a new variety of *C. pseudoprotuberans*. His form closely resembles the present Alaskan form but is larger in size. These three forms might belong to the same species. Pl. 4, fig. 6,

Hab. 116. Distr. Alaska.

C. pseudoprotuberans var. *pygmaeum* GUTW. in MESSIKOMMER, Beitr. geobot. Landesaufn. Schweiz, **24**, p. 147, pl. 5, f. 7, 1942.

Cells 13–14μ long, 11–12μ broad, and isthmus 3–5μ broad. Semicells of the present specimens are obtrapeziform, and the lateral margins are divergent. Apex of semicell somewhat variable, the specimens obtained from no. 115 are convex, and the apex of no. 117 is flattened, sinus of these specimens are perfectly closed. PRINTZ reported var. *trapezoidricum* from Norway and his figure shows the truncate apex. His specimens are slightly larger than those of the Alaskan form but resemble the form reported from Davos by MESSIKOMMER. RYBNICEK reported and figured a similar form from Czechoslovakia, but he did not give a special name to his specimens. WHELDEN reported *C. coarctatum* from arctic Canada, and the figure of his specimens coincides with the present Alaskan specimens. Pl. 4, fig. 9.

Hab. 115, 117. Distr. Europe.

Cosmarium punctulatum BRÉB. in W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 206, pl. 84, f. 13, 14; pl. 52, f. 22, 1908; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, **18**(3), p. 217, pl. 36, f. 21, 1964.

Cells 33–35μ long, 30–31μ broad, and isthmus 8.7–9μ broad.

Hab. 119, 123, 513, 530. Distr. Cosmopolitan.

C. punctulatum var. *subpunctulatum* (NORDST.) BÖRGES. in W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 209, pl. 84, f. 15–20; pl. 85, f. 1–3, 1908.

Cells 30–37.4μ long, 26.4–37μ broad, and isthmus 8–12μ broad. Pl. 6, fig. 14.

Hab. 36, 74, 104, 116, 117. Distr. Alaska, Europe, Siberia, Faeroes, New Zealand and Brazil.

Cosmarium pycnochondrum NORDST. in Öfv. K. Vet.-Akad. Förh., no. 6, p. 23, pl. 6,

f. 14, 1875; W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 244, pl. 88, f. 7, 1908.

Cells 60.7–62μ long, 50–61.6μ broad, and isthmus 16–17.5μ broad.

Hab. 74, 169, 193, 203, 223. Distr. Europe, Spitzbergen, and Greenland.

Cosmarium quadratulum (GAY) DE TONI in W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 121, pl. 72, f. 33; pl. 93, f. 4, 1908; INSAM & KRIEGER, Hedwigia, **76**, p. 106, pl. 3, f. 13, 1936; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, **18**(3), p. 208, pl. 35, f. 24, 25, 1964.

Cells 18–20μ long, 16–17μ broad, and isthmus 3.5–4μ broad. Apex of semicell convex and retuse in the middle, lower margin slightly divergent and retuse. Pl. 4, fig. 4.

Hab. 116. Distr. Europe and Australia.

Cosmarium quadratum RALFS, Br. Desm., p. 92, pl. 15, f. 1a, b, 1848; W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 57, pl. 70, f. 6–8, 1908; SKUJA, Nova Acta R. Soc. Scient. upsal. ser. 4, **18**(3), p. 204, pl. 35, f. 8, 1964.

Cells 44–88μ long, 35–44μ broad, and isthmus 20–27μ broad. Pl. 3, fig. 6, 12.

Hab. 16, 36, 43, 45, 55, 58, 59, 64, 94, 104, 117, 119, 121, 203. Distr. Alaska, U.S.A., Europe, Spitzbergen, Greenland, Novaya Zemlya, Siberia and Japan.

C. quadratum var. *divergens* HIRANO, var. nov.

Semicellulae angusto-subquadratae, marginibus lateralibus inferioribus leviter divergentibus et paene rectis vel paulo retusis, angulis apicalibus late rotundatis, apicibus semicellularum late rectis. Cellulis leviter brevioribus quam in forma typica, 57μ long. 35μ lat. 17μ lat. isth. Pl. 5, fig. 2.

Hab. 72.

Cosmarium quadrifarium LUND. var. *octastichum* NORDST. in IRENÉE-MARIE, Naturaliste can., **75**, p. 163, pl. 2, f. 13, 1948; SKUJA, Nova Acta R. Soc. Scient. upsal. ser. 4, **18**(3), p. 224, pl. 40, f. 6, 1964; CROASDALE, Trans. Am. microsc. Soc., **83**, p. 185, pl. 13, f. 22, 1964.

Cells 48.4–66μ long, 44–48.5μ broad, and isthmus 17–24μ broad.

Hab. 29, 40, 56, 57, 58, 59, 65, 72. Distr. Canada, Devon Island, and Europe.

Cosmarium quadrum LUND., Nova Acta R. Soc. Scient. upsal., ser. 3, **8**, p. 25, pl. 2, f. 11, 1871; W. & G. S. WEST, Monogr. Br. Desm., **4**, p. 20, pl. 100, f. 3–6, 1911; CROASDALE, Trans. Am. microsc. Soc., **84**, p. 323, pl. 4, f. 4, 5, 1965.

Cells 57–60μ long, 49.5–51μ broad, and isthmus 16.3–17μ broad.

Hab. 538. Distr. Canada, Devon Island, U.S.A., Europe, Japan, India, Ceylon, and Sumatra.

C. quadrum var. *minus* NORDST. in W. & G. S. WEST, Monogr. Br. Desm., **4**, p. 21, 1911.

Cells 46-48.5μ long, 39-44μ broad, and isthmus 16-17μ broad.

Hab. 123. Distr. Europe and Greenland.

Cosmarium reniforme (RALFS) ARCH. in W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 157, pl. 79, f.1, 2; pl. 82, f. 15, 1908; CROASDALE, Trans. Am. microsc. Soc., **75**, p. 51, pl. 13, f. 3, 1956.

Cells 66-68μ long, 57-58μ broad, and isthmus 17-18μ broad.

Hab. 59, 74, 93. Distr. Alaska, Devon Island, U.S.A., Europe, Greenland, Spitzbergen, Faeroes, Japan, and S. America.

Cosmarium sexnotatum GUTW. in W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 227, pl. 86, f. 7, 1908; CROASDALE, Trans. Am. microsc. Soc., **75**, p. 51, pl. 14, f. 22, 1956; FÖRSTER, Ark. Bot., ser. 2, **6**(3), p. 148, pl. 6, f. 5-8, 1965.

Cells 25-26.5μ long, 21-22μ broad, and isthmus 7-7.5μ broad. Lateral margin of semicell slightly 6 crenate, apex 4 crenate; cell wall furnished with two concentric and radial series of granules within the margin and a transverse series of three elongated large granules in the centre of semicell. Pl. 6, fig. 12.

Hab. 58. Distr. Alaska and Europe.

Cosmarium simplicius (W. & G. S. WEST) GRÖNBLAD, Comment. Biol., **10**(5), p. 9, pl. 1, f. 18-20, 1948; CROASDALE, Trans. Am. microsc. Soc., **75**, p. 52, pl. 16, f. 16, 1956; FÖRSTER, Ark. Bot., ser. 2, **6**(3), p. 148, pl. 6, f. 2-4, 1965.—*C. elegantissimum* LUND. var. *simplicius* W. & G. S. WEST in J. Linn. Soc., Bot. **33**, p. 308, pl. 17, f. 7, 1898.

Cells 48.4-57μ long, 24-26.5μ broad, and isthmus 21-24μ broad. Pl. 5, fig. 23.

Hab. 55, 76, 123. Distr. Alaska, U.S.A. and Europe.

Cosmarium speciosissimum SCHMIDLE, Öst. bot. Z., p. 24, pl. 15, f. 30, 31, 1895; W. & G.S. WEST, Monogr. Br. Desm., **3**, p. 254, pl. 89, f. 14, 15, 1908; CROASDALE, Trans. Am. microsc. Soc., **81**, p. 30, pl. 5, f. 78, 79, 1962.

Cells 46-48μ long, 37.5-38μ broad, and isthmus 21-22μ broad. Pl. 5, fig. 24.

Hab. 64, 94. Distr. Alaska and Europe.

C. spesiosissimum var. *arcticum* HIRANO, var. nov.

Cellulae minores et breviores quam in forma typica; semicellulae semicirculares (non semiellipticae), marginibus crenulatis, apice convexo et 4-crenulato, crenae non profundiores quam in forma typica; membrana cum serie concentrice crenulis intra marginem crenarum. Cellulae 35-36μ longae, 28.6-29μ latae, 13μ lat. isth. Pl. 7, fig. 3.

Hab. 58.

Cosmarium speciosum LUND., Nova Acta R. Soc. Scient. upsal., ser. 3, **8**, p. 34, pl. 3, f. 5, 1871; W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 247, pl. 89, f. 1-3, 1908; CROASDALE, Trans. Am. microsc. Soc., **84**, p. 324, pl. 5, f. 13, 1965.

Cells 51.5-70μ long, 35-44μ broad, and isthmus 15.4-23.4μ broad. The present specimens coincide with the form reported from Devon Island by CROASDALE by having the radial series of crenae within the marginal crenae. The granulation on the apex and lateral crenae is not seen, and cell wall of semicell has concentric series of crenae instead of bigranulation within the margin. Pl. 1, fig. 1.

Hab. 40, 64, 106, 160, 169, 172, 173, 193, 203. Distr. Alaska, Devon Island, U.S.A., Greenland, Spitzbergen, Novaya Zemlya, Faeroes, Europe, New Zealand, and S. America.

C. speciosum var. *rostaffinskii* (GUTW.) W. & G. S. WEST forma *americana* W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 251, 1908; IRENÉE-MARIE, Naturaliste can., **78**, p. 115, pl. 2, f. 22, 1951.—*C. rostaffinskii* GUTW. var. *americanum* W. & G. S. WEST, J. Linn. Soc., Bot., **33**, p. 304, pl. 17, f. 13, 1898.

Cells 44-46μ long, 30-30.5μ broad, and isthmus 16.7-19μ broad. Semicells of present specimens are subrectangular-subpyramidate or truncate-elliptic, sinus somewhat shallow in the specimens collected in the place of no. 15, lateral margin convex and 4-crenate sometimes with 5 crenations, centre of semicell smooth without any decoration of granules or ridges. Pl. 1, fig. 2.

Hab. 40, 160. Distr. U.S.A. and Canada.

C. speciosum var. *simplex* NORDST. in GRÖNBLAD, Memo. Soc. Fauna Flora fenn., **10**, p. 269, f. 4: 15, 16, 1934; INSAM & KRIEGER, Hedwigia, **76**, p. 108, pl. 4, f. 28, 1936; CROASDALE, Trans. Am. Microsc. Soc., **75**, p. 52, pl. 16, f. 8, 1956.

Cells 46-70μ long, 35-48.4μ broad, and isthmus 13-24μ broad. Semicells semielliptic, apex convex-crenulate, lateral margin crenulate, crenae become smaller from upper to downward and lowermost crena indistinct, central part of semicell smooth. The present specimens are slightly larger than var. *intermedium* reported from Tirol by INSAM & KRIEGER. The specimens obtained from no. 203 coincide with the form reported from N. Russia by GRÖNBLAD. Pl. 9, fig. 9.

Hab. 146, 148, 173, 193, 223, 516. Distr. Alaska and Europe.

Cosmarium subarctoum (LAGERH.) RACIB. in W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 31, pl. 68, f. 6-8, 1908; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, **18**(3), p. 190, pl. 36, f. 1, 2, 1964.

Cells 19-20μ long, 14.5-15μ broad, and isthmus 8.7-9μ broad. Pl. 4, fig. 13.

Hab. 117, 123. Distr. Europe, Greenland, and Argentine.

Cosmarium subcostatum NORDST. in Öfv. K. Vet.-Akad. Förh., no. 6, p. 37, pl. 12, f. 13, 1875; W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 236, pl. 87, f. 3-5, 1908; CROASDALE, Trans. Am. microsc. Soc., **75**, p. 53, pl. 15, f. 18, 19, 1956.

Cells 30-44μ long, 25.5-37μ broad, and isthmus 8.7-11μ broad. Lateral margin of

semicell crenate, upper two crenae distinct and lower two indistinct and show two entire crenae. Lateral margin of typical form consists of 4 larger crenae and two entire crenae, but the size of cell rather belongs to the typical form and to forma *minor* in view of the number of crenae, apical crenation consists of 4 (two central crenae are small and shallow, and both outside crenae larger and more distinct than the central ones). The disposition of the granules on the central tumour of semicell shows a tendency to become concentric and the central granules among series of granules larger than the surrounding ones. Pl. 6, fig. 1.

Hab. 15, 22, 38, 40, 43, 64, 93, 94, 119, 146, 172, 193, 203, 530. Distr. Alaska, Europe, Greenland, Faeroes, and Ceylon.

C. subcostatum forma *minor* W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 238, pl. 87, f. 6-9, 1908; CROASDALE, Trans. Am. microsc. Soc., **75**, p. 53, pl. 15, f. 20, 1956.

Cells 24.6-27μ long, 22-23.5μ broad, and isthmus 6-7μ broad.

Hab. 76, 121. Distr. Alaska, U.S.A., Europe, and Africa.

C. subcostatum var. *beckii* (GUTW.) W. & G. S. WEST in Monogr. Br. Desm., **3**, p. 238, pl. 87, f. 10-12, 1908.

Cells 41-44μ long, 36-37.4μ broad, and isthmus 8-10μ broad. Pl. 6, fig. 3.

Hab. 121. Distr. Europe.

C. subcostatum var. *spetsbergense* BORGE, Vidensk. Skr. math.-nat. Kl., no. 11, p. 18, f. 13, 1911; CROASDALE, Trans. Am. microsc. Soc., **81**, p. 31, pl. 4, f. 65, 1962; FÖRSTER, Ark. Bot., ser. 2, **6**(3), p. 149, pl. 8, f. 4-6, 1965.

Cells 26-27μ long, 22-22.5μ broad, and isthmus 6-6.5μ broad. Pl. 6, fig. 11.

Hab. 58. Distr. Alaska, Europe, and Spitzbergen.

Cosmarium subcrenatum HANTZ. in W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 228, pl. 86, f. 10-14, 1908; CROASDALE, Trans. Am. microsc. Soc., **75**, p. 53, pl. 15, f. 12, 1956; *l.c.* **84**, p. 326, pl. 5, f. 7-10, 1965.

Cells 25.5-35μ long, 24-26.5μ broad, and isthmus 6.5-10μ broad. Pl. 9, fig. 3.

Hab. 14, 15, 16, 25, 26, 28, 29, 30, 36, 38, 44, 45, 53, 55, 56, 61, 65, 74, 106, 112, 115, 116, 117, 123, 146, 148, 158, 193, 523, 536, 538. Distr. Alaska, Canada, Devon Island, Europe and Japan.

Cosmarium subcucumis SCHMIDLE in W. & G. S. WEST, Monogr. Br. Desm., **2**, p. 155, pl. 60, f. 1-3, 1905.

Cells 53-66μ long, 33-40μ broad, and isthmus 15.4-22μ broad. Pl. 3, fig. 11, 13.

Hab. 55, 65, 74, 76, 112. Distr. Alaska, Canada and Europe.

Cosmarium subglobosum NORDST. in INSAM & KRIEGER, Hedwigia, **76**, p. 109, pl. 1, f. 8, 1936.

Cells 46-48μ long, 24-28μ broad. and isthmus 22μ broad. Pl. 3, fig. 8.

Hab. 30, 74, 172. Distr. Europe.

Cosmarium subochthodes SCHMIDLE var. *scrobiculatum* (MESSIK.) CROASDALE, Trans. Am. microsc. Soc., **75**, p. 54, pl. 17, f. 12, 1956.

Cell 95μ long, 70μ broad, and isthmus 17.5μ broad. Cell wall granulate-scrobiculate, granules slightly flattened and the scrobiculations disposed on the top of each ganule. Pl. 6, fig. 15.

Hab. 58. Distr. Alaska.

Cosmarium subquasillus BOLDT in Bih. K. Svenska Vet.-Akad. Handl., **13**, Afd. 3, no. 5, p. 25, pl. 1, f. 25, 1887.

Cells 67-70μ long, 61.5-68μ broad, and isthmus 17μ broad. Semicells truncate-semicircular or subtrapeziform, lateral margin crenate, crenae 7 including apical and basal angles, apex shallow crenate, crenae 4 including both apical angles, all the crenae bigranulate; cell wall furnished with 3 or 4 concentric series of binate granules within each lateral and apical crena, granulate series increases and becomes irregular in number near the sinus, central tumour furnished with concentric series of granules which are somewhat larger than the marginal ones. There is a smooth space between the marginal series of granules and central granulate tumour. MESSIKOMMER reported a form similar to the present species from Switzerland known as *C. quasillus* var. *calvum* KAISER. I have not yet seen KAISER's original figure, but it seems to be a reduced form of *C. subquasillus*, judging from MESSIKOMMER's figure, namely, lateral crenae are indistinctly bigranulate, and the produced apical part of semicell seems to suggest that KAISER's variety does not belong to *C. quasillus* but to *C. subquasillus*. Recently CROASDALE reported *C. quasillus* forma *debonense* from Devon Island, but I feel it belongs to *C. subquasillus* which was reported first from Greenland. Pl. 9, fig. 11.

Hab. 536, 538. Distr. Greenland.

Cosmarium subspeciosum NORDST. in Öfv. K. Vet.-Akad. Förh., no. 6, p. 22, pl. 6, f. 13, 1875; BÖRGESEN, Meddr. Grönland, **43**, p. 83, f. 4, 1910; W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 252, pl. 89, f. 11, 1908.

Cells 61-70μ long, 48-56μ broad, and isthmus 20-22μ broad. Pl. 5, fig. 25.

Hab. 15, 65, 172, 205, 223. Distr. U.S.A., Europe, Spitzbergen, Greenland, Novaya Zemlya, Ceylon, Africa, Madagascar, and Brazil.

C. subspeciosum var. *transiens* MESSIKOMMER, Beitr. geobot. Landesaufn. Schweiz, **24**, p. 155, pl. 9, f. 4-8, 1942.

Cells 39-53μ long, 31-37μ broad, and isthmus 11-16μ broad. Pl. 9, fig. 8.

Hab. 22, 72, 148, 169, 203. Distr. Europe.

Cosmarium subtumidum NORDST. in W. & G. S. WEST, Monogr. Br. Desm., **2**, p. 192, pl. 63, f. 18–20, 1905.

Cell 35μ long, 35μ broad, and isthmus 12μ broad.

Hab. 115. Distr. Alaska, Devon Island, Europe, Greenland, Japan, Australia, Central Africa, and Brazil.

*C. **subtumidum*** var. ***groenbladii*** CROASDALE in Trans. Am. microsc. Soc., **83**, p. 187, pl. 11, f. 26, 27, 1964.

Cells 48–48.6μ long, 38.3–38.7μ broad, and isthmus 22μ broad. The specimens coincide with the form reported from Labrador by CROASDALE. The outline of semicell is variable and two semicells of the same individual are sometimes different from each other. The dimensions of the present specimens are slightly larger than those given by the previous author. Pl. 4, fig. 17.

Hab. 116. Distr. Canada.

*C. **subtumidum*** var. ***klebsii*** (GUTW.) W. & G. S. WEST in Monogr. Br. Desm., **2**, p. 193, pl. 63, f. 21, 22, 23, 1905.

Cells 34–36μ long, 29.5–30μ broad, and isthmus 8μ broad.

Hab. 121. Distr. Alaska and Europe.

*C. **subtumidum*** var. ***rotundum*** HIRANO, Acta phytotax. geobot., **14**, p. 70, f. 2, 1951; Contr. Biol. Lab. Kyoto Univ., **4**, p. 133, pl. 22, f. 8, 1957.

Cells 31–33μ long, 22–23μ broad, and isthmus 7.5–8μ broad. Pl. 4, fig. 11.

Hab. 116, 117, Distr. Japan.

Cosmarium subundulatum WILLE in CROASDALE, Trans. Am. microsc. Soc., **75**, p. 55, pl. 3, f. 12, 1956; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, **18**(3), p. 195, pl. 32, f. 22–24, 1964.

Cells 53–66μ long, 44–45μ broad, and isthmus 15.5–17μ broad. Pl. 4, fig. 19.

Hab. 30, 33, 55, 56, 58, 59, 76, 94, 121, 123. Distr. Alaska, Canada and Europe.

Cosmarium supraspeciosum WOLLE, Desm. U.S. p. 88, pl. 50, f. 5, 6, 1884.

Cells 79–91μ long, 66–68μ broad, and isthmus 22μ broad. Margin crenulate-granulate; cells furnished with radial and concentric series of pairs of granules on and within each crena, and another series of granules on the median part of semicell, granules are disposed in 6 vertical series and are slightly arcuate. Pl. 5, fig. 26.

Hab. 94, 538. Distr. U.S.A.

Cosmarium tatricum RACIB. in W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 45, pl. 69, f. 10, 1908; GRÖNBLAD, Acta Soc. Sci. fenn., n. ser. B, **2**(5), p. 39, pl. 3, f. 12, 1942.

Cells 26.5–28μ long, 17.6–18μ broad, and isthmus 9–9.5μ broad. The specimens coincide well with the form reported by GRÖNBLAD, and are rather smaller than the

dimensions of British forms described by WEST.

Hab. 169. Distr. Alaska and Europe.

C. tatricum forma *minor* MESSIKOMMER, Beitr. geobot. Landesaufn. Schweiz, **24**, p. 149, pl. 6, f. 7, 1942.

Cell 23μ long, 15.4μ broad, and isthmus 7.5μ broad. The present specimens coincide well with the forms reported from Davos. The sinus is closed and moderately deep. KRIEGER reported a similar form from Spitzbergen by the name of *E. sublobatum* var. *kriegeri*, but the sinus of *E. sublobatum* is deep, yet not as deep as in the *C. tatricum*. Pl. 6, fig. 5.

Hab. 160. Distr. Europe.

Cosmarium tetragonum NÄG. var. *heterocrenatum* W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 19, pl. 66, f. 22, 1908; GRÖNBLAD, Acta Soc. Sci. fenn., B, **2**(5), p. 39, pl. 3, f. 21, 1942.

Cells 36–38.7μ long, 26.4–28.6μ broad, and isthmus 15–17μ broad. Apex of semicells in the present specimens is 4 crenated, lateral margins 4 or 5 crenated, three superior crenae including apical angles on each side are larger than those of the inferior ones. Sinus somewhat linearly open and coincides with the North European forms. According to the description and figure by WEST of the British forms, sinus narrowly linear and has deeper constrictions than those of the figure given by GRÖNBLAD; however, there is another form belonging to the present form, having somewhat larger size and much crenated lateral margin (7 crenae including apical and basal angles) in the collection from the same place. Lateral crenae becoming gradually smaller toward the base in the present forms. INSAM & KRIEGER reported the similar form from Tirol under the separate name (*C. notabile* var. *transiens* INSAM & KRIEGER) but their forms differ from the present form in the nature of sinus. Pl. 2, fig. 2.

Hab. 148, 169. Distr. Europe (Britain)

Cosmarium tetraophthalmum BRÉB. in W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 270, pl. 95, f. 4–7, 1908; CROASDALE, Trans. Am. microsc. Soc., **75**, p. 57, pl. 17, f. 1, 1956.

Cells 106–126μ long, 75–88μ broad, and isthmus 28.7–35μ broad.

Hab. 22, 56, 64, 76, 115, 121. Distr. Cosmopolitan.

Cosmarium tuddalense STRÖM, Nyt Mag. Naturvid., **57**, p. 171, pl. 4, f. 8, 1920.

Cell 141μ long, 101μ broad, and isthmus 31μ broad. Pl. 7, fig. 6, 7.

Hab. 115. Distr. Europe.

Cosmarium tumidum LUND. in W. & G. S. WEST, Monogr. Br. Desm., **2**, p. 160, pl. 60, f. 18, 1905; CROASDALE & GRÖNBLAD, Trans. Am. microsc. Soc., **83**, p. 188, pl. 10, f. 16–18, 1964; FÖRSTER, Ark. Bot., ser. 2, **6**(3), p. 152, pl. 3, f. 22, 23, 1965.

Cells 37.4-44μ long, 26.5-35μ broad, and isthmus 6.5-10μ broad. Outline of semicell variable, subsemicircular-elliptic to reniform, sinus closed; cells in vertical view elliptic-rhomboid, with a broad inflation on each side. INSAM & KRIEGER reported *C. pseudoprotuberans* var. *borgei* from Tirol. Its semicell is reniform and coincide with some of the specimens collected from nos. 29 and 58. NORDSTEDT reported *C. pseudoprotuberans* var. *angustius* from New Zealand resembling var. *borgei*, although var. *angustius* is the first name of these forms. Pl. 3, fig. 4, 5.

Hab. 29, 30, 43, 50, 55, 57, 58, 59, 74, 119, 123. Distr. U.S.A., Alaska, Greenland and Europe.

Cosmarium turpinii BRÉB. var. *eximium* W. & G. S. WEST, Monogr. Br. Desm., **3**, p. 192, pl. 83, f. 3, 1908; FÖRSTER, Ark. Bot., ser. 2, **6**(3), p. 152, pl. 7, f. 4, 1965.

Cells 57-70μ long, 51-64μ broad, and isthmus 14-17μ broad. Pl. 8, fig. 5.

Hab. 26, 28, 29, 30, 53, 55, 59, 61, 65, 74, 93, 105, 121. Distr. Alaska, Devon Island, and Europe.

Cosmarium undulatum CORDA var. *alaskanum* CROASDALE forma *reductum* CROASDALE, Trans. Am. microsc. Soc., **75**, p. 59, pl. 3, f. 9, 1956.

Cells 35-39.6μ long, 27-28.6μ broad, and isthmus 8.7-9μ broad. The Alaskan form is similar to *C. subimpressulum*, while the number of undulations on each lateral margin is one more than those of his species. Pl. 4, fig. 2.

Hab. 117, 123. Distr. Alaska.

C. undulatum var. *crenulatum* (NÄG.) WITTR. in W. & G. S. WEST, Monogr. Br. Desm., **2**, p. 150, pl. 59, f. 11, 12, 1905.

Cells 22-25.5μ long, 17.6-24.5μ broad, and isthmus 6.5-8.6μ broad. In general the present specimens are slightly smaller than the European description, but coincide with the outline of cell. CROASDALE reported a small form belonging to this variety as forma *minus* from Alaska, and the present forms coincide well with the Alaskan form in size and in outline. The specimens collected at no. 515 represent the intermediate size between the size given by WEST and the dimensions by CROASDALE.

Hab. 57, 106, 117, 121, 536, 538. Distr. Europe, Spitzbergen, Bornholm, Japan, India and Brazil.

C. undulatum var. *crenulatum* forma *minus* CROASDALE, Trans. Am. microsc. Soc., **75**, p. 59, pl. 3, f. 10, 1956.

Cells 20.7-24μ long, 16.7-19μ broad, and isthmus 5.7-6.6μ broad. BORGE already reported var. *reinschii* ISTV. from Arctic. BORGE's forms are distinguished from the present form by the small ratio of the length of cell to its breadth.

Hab. 56, 115, 118. Distr. Alaska.

Cosmarium vexatum West var. *lacustre* Messikommer, Vjschr. naturf. Ges. Zürich, **80**, p. 51, pl. 5, f. 62, 1935.—var. *concavum* Schmidle in Ber. dt. bot. Ges., **11**, p. 550, pl. 28, f. 21, 1895; Insam & Krieger, Hedwigia, **76**, p. 111, pl. 6, f. 5, 1936.

Cells 55–57μ long, 46–53μ broad, and isthmus 13–16μ broad. Pl. 8, fig. 8.

Hab. 94, 123. Distr. Europe.

Cosmarium wollei (W. & G. S. West) Grönblad, Acta Soc. Fauna Flora fenn., **66** (1), p. 25, pl. 1, f. 8, 9, 1947; Irenée-Marie, Hydrobiol., **4**, p. 138, pl. 12, f. 10, 1952.

Cells 46.5–48.4μ long, 31–31.4μ broad, and isthmus 26.4–28.6μ broad. Pl. 3, fig. 14.

Hab. 148, 172, 173. Distr. Canada.

Cosmarium woronichinii Kossinskaya, Acta Trudy bot. Inst. Acad. Nauk. SSSR., ser. 2, **3**, p. 431, pl. 3, f. 11, 1936; Croasdale, Trans. Am. microsc. Soc., **81**, p. 31, pl. 5, f. 86, 1962.

Cells 80–97μ long, 62–66μ broad, and isthmus 24–39μ broad. Pl. 8, fig. 4.

Hab. 29, 30, 55, 57. Distr. Siberia and Alaska.

Arthrodesmus convergens Ehrenb. var. *xanthioides* Grönblad, Acta Soc. Fauna Flora fenn., **47**, p. 53, pl. 4, f. 34, 35, 1920.

Cells 74–75μ long, 79–80μ broad without spine, and isthmus 19–20μ broad.

Hab. 116. Distr. Europe.

Arthrodesmus extensus (Anders.) Hirano, Contr. Biol. Lab. Kyoto Univ., **5**, p. 210, pl. 29, f. 16, 1957.

Cells 22–28.6μ long, 21–24μ broad without spine, and isthmus 5.7–9μ broad.

Hab. 56, 59, 65, 123. Distr. New Foundland, Europe and Japan.

Arthrodesmus incus (Bréb.) Hass. var. *borgesenii* Messikommer in Beitr. geobot. Landesaufn. Schweiz, **24**, p. 160, pl. 11, f. 3, 1942.

Cells without spine 27.3–33μ long, 28.6–33.4μ broad without spine, and isthmus 12.5–13μ broad. The present specimens are slightly larger than the forms known from central Europe, spines horizontal. Hirn reported the same form from Finland under the name of *A. incus*. Pl. 10, fig. 13.

Hab. 43, 93. Distr. Europe.

Arthrodesmus incus var. *vulgaris* Eichl. & Racib. forma *recta* Eichl. & Racib. in Förster, Ark. Bot., ser. 2, **6**(3), p. 152, pl. 9, f. 23, 1965.

Cells without spine 46–46.5μ long, 46–46.5μ broad without spine, and isthmus 15–15.4μ broad. Pl. 10, fig. 14.

Hab. 121. Distr. Europe.

Arthrodesmus ralfsii W. West in J. Linn. Soc., Bot., **29**, p. 168, 1892; Smith, Wis.

Bull., **57**, p. 129, pl. 85, f. 9–12, 1924. — *A. incus* (BRÉB.) HASS. var. *ralfsii* W. & G. S. WEST forma *latiuscula* W. & G. S. WEST, Monogr. Br. Desm., **4**, p. 96, pl. 114, f. 5, 1911.

Cells 22–23μ long, 19.5–21μ broad without spine, and isthmus 7μ broad. Pl. 5, fig. 27.

Hab. 61, Distr. U.S.A. and Europe.

A. ralfsii var. *brebissonii* (RACIB.) SMITH in Wis. Bull., **57**. p. 130, pl. 85, f. 13–17, 1924.

Cells 39–40μ long, 35μ broad without spine, and isthmus 10μ broad. Pl. 10, fig. 12.

Hab. 56. Distr. U.S.A.

A. ralfsii var. *subhexagonum* (WEST) HIRANO, comb. nov.

A. incus (BRÉB.) HASS. var. *ralfsii* W. & G. S. WEST forma *subhexagona* WEST, Monogr. Br. Desm., **4**. p. 96, pl. 114, f. 6, 1911.

Cells 26–28.6μ long, 28–30.6μ broad without spine, and isthmus 5–7μ broad. Pl. 10, fig. 15.

Hab. 115. Distr. Europe.

Arthrodesmus triangularis LAGERH. in W. & G. S. WEST, Monogr. Br. Desm., **4**, p. 97, pl. 114, f. 11–13, 1911.

A. triangularis var. *alaskanum* HIRANO, var. nov.

Cellulae latiores quam in forma typica, isthmo elongato, sinu excavato, apice recto vel leviter convexo. Cellula 21μ longa, 22μ lata sine spinis, 9.7μ lat. isth. Pl. 10, fig. 11.

Hab. 26.

Xanthidium antilopaeum (BRÉB.) KÜTZ. in W. & G. S. WEST, Monogr. Br. Desm., **4**, p. 63, pl. 108, f. 7–18, 1911; GRÖNBLAD, Acta Soc. Fauna Flora fenn., **49**, p. 44, pl. 4, f. 1–7, 1921; CROASDALE, Trans. Am. microsc. Soc., **76**, p. 120, pl. 1, f. 1, 1957.

Cells without spine 57–84μ long, 61.5–80μ broad, and isthmus 19–24μ broad.

Hab. 40, 58, 112, 115, 116, 123. Distr. Alaska, Canada, Devon Island, U.S.A., Europe, Faeroes, Bornholm, Siberia, Japan and S. America.

X. antilopaeum var. *crameri* GRÖNBLAD, Acta Soc. Fauna Flora fenn., **49**(7), p. 47, pl. 4, f. 28, 29, 1921.

Cells without spine 59–60μ long, 51–62μ broad, and isthmus 17–17.5μ broad. The present specimens are distinguished from the original form described by GRÖNBLAD from Finland by having the depressed semicell and linearly open sinus, but coincide with the latter in the disposition of central scrobiculations, which gradually become smaller in size from middle to both ends. Pl. 10, fig. 16.

Hab. 117, 123. Distr. Canada and N. Europe.

X. antilopaeum var. *laeve* SCHMIDLE in W. & G. S. WEST, Monogr. Br. Desm., **4**, p. 68, pl. 109, f. 3, 1911; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, **18**(3), p. 230, pl. 42,

f. 2, 1964.

Cells without spine 79–84μ long, 70–75μ broad, and isthmus 22–26.5μ broad. The present specimens are larger than the typical form and the sinus is open. Semicells are without a series of central scrobiculations.

Hab. 36. Distr. Europe.

X. antilopaeum var. *laeve* SCHMIDLE forma *incrassata* GRÖNBLAD, Acta Soc. Fauna Flora fenn., **49**(7), p. 46, pl. 4, f. 19, 20, 1921.

Cells without spine 79–84μ long, 74.7–75μ broad, and isthmus 22μ broad.

Hab. 115. Distr. N. Europe.

Xanthidium cristatum BRÉB. var. *leiodermum* (ROY & BISS.) TURNER in W. & G.S. WEST, Monogr. Br. Desm., **4**, p. 72, pl. 110, f. 11, 1911; CROASDALE & GRÖNBLAD, Trans. Am. microsc. Soc., **83**, p. 190, pl. 16, f. 9–13, 1964.

Cells without spine 60–63.7μ long, 47–50.6μ broad, and isthmus 13.5–15.4μ broad.

Hab. 123. Distr. Canada, U.S.A., Europe, Japan and India.

Xanthidium fasciculatum EHRENB. var. *ornatum* NORDST. in Öfv. K. Vet.-Akad. Förh., no. 2, p. 12, pl. 7, f. 10, 1885.

Cells without spine 53–62μ long, 50.6–53μ broad, and isthmus 17.6–26.4μ broad. Central granules situated in the middle of semicell are slightly larger than those of the figures given by NORDSTEDT from Greenland, and their disposition is variable. Paired spines are long in some specimens and short in others. Pl. 11, fig. 7.

Hab. 36, 76, 104. Distr. Greenland.

Euastrum bidentatum NÄG. in W. & G.S. WEST, Monogr. Br. Desm., **2**, p. 39, pl. 37, f. 16–19, 1905; KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 601, pl. 85, f. 1, 2, 1937; CROASDALE, Trans. Am. microsc. Soc., **83**, p. 162, pl. 7, f. 1, 2, 1964.

Cells 48–70μ long, 33–39.6μ broad, and isthmus 8.8–13μ broad.

Hab. 14, 16, 22, 29, 40, 55, 56, 57, 58, 59, 61, 64, 65, 74, 76, 94, 104, 106, 115, 116, 117, 119, 123, 223, 513, 515. Distr. Alaska, Canada, Devon Island, U.S.A., Europe, Iceland, Bornholm, Japan and Brazil.

Euastrum binale (Turp.) EHRENB. var. *gutwinskii* SCHMIDLE in W. & G.S. WEST, Monogr. Br. Desm., **2**, p. 53, pl. 38, f. 31, 32, 1905; KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 551, pl. 75, f. 13–15, 1937; CROASDALE & GRÖNBLAD, Trans. Am. microsc. Soc., **83**, p. 164, pl. 7, f. 13–15, 1964.

Cells 22–25.5μ long, 16.7–22μ broad, and isthmus 4.4–6.6μ broad.

Hab. 14, 16, 29, 40, 55, 56, 58, 59, 61, 65, 74, 76, 94. Distr. Alaska, Canada, Europe and Japan.

Euastrum boldtii SCHMIDLE in KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 563, pl. 77,

f. 5-7, 1937.

Cells 31-37.4μ long, 15.5-26.4μ broad, and isthmus 6.5-8.7μ broad. There are two different forms in the collections: sgme specimens bear distinct acute granules on the margin of lateral lobes and others are wanting. The apex of polar lobe is convex and retuse in the middle, but in some specimens it is undulate. The size of cells is larger than the dimensions given by KRIEGER. The distinction between the typical form and its variety is not so distinct on the present specimens. Pl. 11, fig. 1, 2.

Hab. 29, 55, 57, 58, 59, 61. Distr. New Foundland, Europe, and Greenland.

Euastrum dubium NÄG. in W. & G. S. WEST, Monogr. Br. Desm., **2**, p. 43, pl. 38, f. 5-8, 1905; KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 571, pl. 79, f. 1-5, 1937.

Cells 25.5-27μ long, 17.6-18.7μ broad, and isthmus 5μ broad.

Hab. 119, 536. Distr. Canada, U.S.A., Europe, Greenland, Spitzbergen, Siberia, Japan, Mongolia and Africa.

E. dubium var. *ornatum* WOLOSZ. in KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 572, pl. 79, f. 10, 1937.

Cells 26.4-48.5μ long, 24-35μ broad, and isthmus 6.5-9μ broad.

Hab. 30, 104. Distr. Europe.

Euastrum elegans (BRÉB.) KÜTZ. in W. & G. S. WEST, Monogr. Br. Desm., **2**, p. 48, pl. 38, f. 16, 17, 21, 1905; GRÖNBLAD, Acta Soc. Fauna Flora fenn., **47**, p. 31, pl. 6, f. 34, 1920; KRIEGER, Kryptogamenflora **13**, Abt. 1, p. 591, pl. 81, f. 14-18, 1937.

Cells 33-39.6μ long, 22-26.4μ broad, and isthmus 4.5-6.5μ broad. Pl. 10, fig. 4.

Hab. 14, 16, 29, 30, 36, 40, 55, 56, 58, 59, 61, 64, 65, 74, 76, 94, 115, 117, 121, 123. Distr. Alaska, Canada, U.S.A., Europe, Spitzbergen, Greenland, Novaya Zemlya, Bornholm, Siberia and Japan.

Euastrum obesum JOSHUA in W. & G. S. WEST, Monogr. Br. Desm., **2**, p. 29, pl. 36, f. 16, 17, 1905; KRIEGER, Kryptogamenflora, **13**, Abt. 1, p. 495, pl. 59, f. 9, 10, 1937; CROASDALE & GRÖNBLAD, Trans. Am. microsc. Soc., **83**, p. 168, pl. 6, f. 14, 1964.

Cells 84-97μ long, 44-48.5μ broad, and isthmus 13-19.5μ broad. Pl. 10, fig. 8.

Hab. 29, 30, 55, 56, 57, 58, 59, 61, 64, 65, 74, 76, 94, 104, 116, 119. Distr. Canada, U.S.A., Europe, India, Ceylon, Sumatra, Burma and Africa.

Euastrum oblongum (GREV.) RALFS in W. & G. S. WEST, Monogr. Br. Desm., **2**, p. 12, pl. 34, f. 7-9; pl. 35, f. 2, 1905; KRIEGER, Kryptogamenflora, **13**, Abt. **1**, p. 526, pl. 70, f. 3-6, 1937; CROASDALE, Farlowia, **4**, p. 532, pl. 11, f. 1, 1955.

Cells 150-158.5μ long, 66-73.5μ broad, and isthmus 22-24μ broad.

Hab. 56, 57. Distr. Canada, U.S.A., Europe, Greenland, Faeroes, Bornholm, Japan and Brazil.

Euastrum pectinatum Bréb. var. *brachylobum* Wittr. in W. & G. S. West, Monogr. Br. Desm., **2**, p. 62, pl. 39, f. 16, 1905; Grönblad, Acta Soc. Sci. fenn., n.ser. B, **2**(5), p. 36, pl. 1, f. 24, 1942; Croasdale, Farlowia, **4**, p. 532, pl. 11, f. 8, 1955.

Cells 75–79μ long, 53–53.4μ broad, and isthmus 13–17.5μ broad. Pl. 10, fig. 7.

Hab. 56, 61. Distr. Canada, New Foundland, Greenland, and Europe.

Euastrum subalpinum Messikommer in Vjschr. naturf. Ges. Zürich, **80**, p. 120, pl. 1, f. 5, 1935; Krieger, Kryptogamenflora. **13**, Abt. 1, p. 569, pl. 77, f. 35–37, 1937.

Cells 26–30μ long, 17–20μ broad, and isthmus 6.5–8μ broad. The present specimens are larger than the dimension given by Krieger but coincide well with the outline of cell. Polar lobe somewhat elongate and slightly dilated upward, and sometimes slightly longer than the basal part of semicell. Croasdale reported var. *crassum* of this species from Labrador, but the present specimens do not coincide with it. Pl. 10, fig. 2, 3.

Hab. 104, 223. Distr. Canada and Europe.

Euastrum turneri W. West, Monogr. Br. Desm., **2**, p. 37, pl. 37, f. 9, 10, 1905; Krieger, Kryptogamenflora, **13**, Abt. 1, p. 589, pl. 82, f. 20, 21, 1937.

Cells 30–42μ long, 22–31μ broad, and isthmus 6.5–7.5μ broad.

Hab. 30, 40, 104, 123. Distr. Canada, U.S.A., Europe, Japan, Manchuria, Australia and S. America.

Euastrum verrucosum Ehrenb. in W. & G. S. West, Monogr. Br. Desm., **2**, p. 64, pl. 40, f. 1, 1905; Krieger, Kryptogamenflora, **13**, Abt. 1, p. 643, pl. 94, f. 1–3, 1937.

Cells 97–99μ long, 75–78μ broad, and isthmus 22–22.5μ broad.

Hab. 40, 56, 59, 65, 74, 119. Distr. U.S.A., Canada, Greenland, Europe, Faeroes, Bornholm, Siberia, Japan, Australia, S. America and Africa.

E. verrucosum var. *alatum* Wolle in W. & G. S. West, Monogr. Br. Desm., **2**, p. 67, pl. 40, f. 6, 1905; Krieger. Kryptogamenflora, **13**, Abt. 1, p. 645, pl. 94, f. 4, 1937.

Cells 120–132μ long, 103–110μ broad, and isthmus 24–26.5μ broad. The present forms coincide well with the description and figure given by Krieger. Cell wall furnished with a concentric series of granules just above the isthmus and the inner granules are distinctly larger than the peripheral ones. Lateral lobes of the semicell seems to be somewhat produced.

Hab. 117. Distr. Canada, U.S.A., and Europe.

Micrasterias americana (Ehrenb.) Ralfs in W. & G. S. West, Monogr. Br. Desm., **2**, p. 117, pl. 53, f. 4, 5, 1905; Krieger, Kryptogamenflora, **13**, Abt. 2, p. 45, pl. 108, f. 5–8, 1939.

Cells 132–154μ long, 114–128μ broad, and isthmus 26.5–32μ broad.

Hab. 536, 538. Distr. U.S.A. and Europe.

Micrasterias angulosa HANTZSCH in GRÖNBLAD, Acta Soc. Fauna Flora fenn., **47**, p. 33, pl. 6, f. 4, 5, 1920.—*M. denticulata* BRÉB. var. *angulosa* (HANTZSCH) W. & G. S. WEST in Monogr. Br. Desm., **2**, p. 107, pl. 50, f. 3, 4, 1905.

Cells 258–264μ long, 175–190μ broad, and isthmus 32–35μ broad.

Hab. 61. Distr. Europe, Greenland, Bornholm, Japan, and New Zealand.

Micrasterias brachyptera LUND. in Nova Acta R. Soc. Scient. upsal. ser. 3, **8**, p. 12, pl. 1, f. 4, 1871; KRIEGER, Kryptogamenflora, **13**, Abt. 2, p. 83, pl. 125, f. 3–6, 1939.

Cells 220–223μ long, 150–154μ broad, and isthmus 22–22.5μ broad.

Hab. 115. Distr. Europe.

Micrasterias denticulosa BRÉB. in W. & G. S. WEST, Monogr. Br. Desm., **2**, p. 105, pl. 50, f. 1, 4, 1905; GRÖNBLAD, Acta Soc. Fauna Flora fenn., **47**, p. 35, 1920; KRIEGER, Kryptogamenflora, **13**, Abt. 2, p. 105, pl. 137, f. 3–6, 1939.

Cells 246–260μ long, 185–205μ broad, and isthmus 26.5–35μ broad.

Hab. 64, 76, 104. Distr. U.S.A., Europe, Greenland, Faeroes, Japan, India, Sumatra, Australia, New Zealand, and Brazil.

Micrasterias sol (EHRENB.) KÜTZ. var. *ornata* NORDST. in W. & G. S. WEST, Monogr. Br. Desm., **2**, p. 97, pl. 46, f. 3, 4, 1905; KRIEGER, Kryptogamenflora, **13**, Abt. 2, p. 96, pl 131, f. 3–5, 1939.

Cells 134–141μ long, 114–119μ broad, and isthmus 18–20μ broad.

Hab. 119. Distr. U.S.A., Europe and Brazil.

Staurastrum aculeatum (EHRENB.) MENEGH. var. *ornatum* NORDST. in KRIEGER, Ber. dt. bot. Ges., **56**, p. 64, pl. 2, f. 5, 6, 1938; CROASDALE, Trans. Am. microsc. Soc., **76**, p. 136, pl. 7, f. 110, 1957; *l.c.* **84**, p. 329, pl. 8, f. 13, 1965.

Cells 34–35μ long, 37.4–38μ broad, and isthmus 13μ broad. Pl. 11, fig. 11.

Hab. 16, 65. Distr. Alaska, Devon Island and Spitzbergen.

S. aculeatum var. *ornatum* forma *simplex* BOLDT in CROASDALE, Trans. Am. microsc. Soc., **84**, p. 329, pl. 8, f. 14–16, 1965.

Cells 34–35μ long, 33–35μ broad, and isthmus 9–9.5μ broad. Pl. 12, fig. 6.

Hab. 56. Distr. Devon Island.

Staurastrum alternans BRÉB. in W. & G. S. WEST, Monogr. Br. Desm., **4**, p. 170, pl. 126, f. 8, 9, 1911; FÖRSTER, Ark. Bot., ser. 2, **6**(3), p. 152, pl. 8, f. 15, 1965.

Cells 30–40.5μ long, 30–44μ broad, and isthmus 9–15μ broad. Semicells subelliptic, lateral angles slightly produced and truncated, sinus widely open but acuminate at the extremity; lateral margin retuse in the vertical view of semicell; cell wall granulate, granules disposed in concentric series of about 5–6 around the angle.

Hab. 118, 536, 538. Distr. Cosmopolitan.

S. alternans var. *basichondrum* SCHMIDLE in CROASDALE, Trans. Am. microsc. Soc., **81**, p. 36, pl. 7, f. 125, 1962.

Cells 31–37.4μ long, 31–39.5μ broad, and isthmus 10–12μ broad. Pl. 13, fig. 7.

Hab. 15, 16, 22, 40, 43, 59, 118, 193, 513. Distr. Alaska and Europe.

Staurastrum apiculatum BRÉB. in WEST & CARTER, Monogr. Br. Desm., **5**, p. 6, pl. 129, f. 6–8, 1923.

Cells 21–23μ long, 21–23μ broad, and isthmus 6μ broad.

Hab. 121. Distr. U.S.A., Europe, Greenland, Japan, Burma, Thailand and Australia.

Staurastrum avicula BRÉB. in WEST & CARTER, Monogr. Br. Desm., **5**, p. 40, pl. 133, f. 8–10, 1923; GRÖNBLAD, Acta Soc. Fauna Flora fenn., **47**, p. 57, pl. 3, f. 36–38, 1920.

Cells 33–34μ long, 31–37μ broad, and isthmus 6.6–7μ broad.

Hab. 57. Distr. Alaska, Devon, Island, U.S.A., Europe, Greenland, Faeroes, Japan, and Brazil.

Staurastrum bieneanum RABENH. forma *spetsbergensis* NORDST. in Öfv. K. Vet.-Akad. Förh., no. 6, p. 33, pl. 8, f. 35, 1875; W. & G. S. WEST, Monogr. Br. Desm., **4**, p. 137, pl. 120, f. 7, 1911; KRIEGER, Ber. dt. bot. Ges., **56**, p. 64, pl. 2, f. 3, 4, 1938.

Cells 30–31μ long, 30–31μ broad, and isthmus 8.7–9μ broad. The cell form corresponds well to the form reported from Spitzbergen, but the cells are slightly smaller than his form. Similar form was reported from central Europe by MISSIKOMMER under the name of var. *ellipticum*. Semicells of the present specimens are almost elliptic, but the ventral margin more convex than the dorsal one, and the lateral angles are acutely rounded. Pl. 11, fig. 13.

Hab. 59. Distr. Alaska, Spitzbergen, Greenland, Faeroes, and Siberia.

St. bieneanum var. *ellipticum* WILLE in W. & G. S. WEST, Monogr. Br. Desm., **4**, p. 137, pl. 120, f. 8, 1911; GROASDALE, Trans. Am. microsc. Soc., **76**, p. 142, pl. 4, f. 58, 1957.

Cells 33–35μ long, 31–33μ broad, and isthmus 8–9μ broad. Pl. 11, fig. 8.

Hab. 61. Distr. Alaska, Europe, Spitzbergen, Greenland, Samoa and Australia.

Staurastrum boldtianum GRÖNBLAD, Acta Soc. Sci. fenn., n.ser. B, **2**(5), p. 40, pl. 4, f. 4, 1942; FÖRSTER, Ark. Bot., ser. 2, **6**(3), p. 153, pl. 9, f. 15–17, 1965.

Cells 26–28.6μ long, 26.5–29μ broad, and isthmus 11μ broad. Pl. 10, fig. 1.

Hab. 22. Distr. Europe.

Staurastrum borgeanum SCHMIDLE in THOMASSON, Bot. Notiser, **110**, p. 260, f. 5, 1957; CROASDALE, Trans. Am. microsc. Soc., **81**, p. 36, pl. 8, f. 135–141, 1962; FÖRSTER, Ark. Bot., ser. 2, **6**(3), p. 153, pl. 9, f. 1, 2, 1965.

Cells 40–44μ long, 48.4–55μ broad including process, and isthmus 13–15μ broad. Body of semicells elliptic-subfusiform or depressed cup-shaped, apex convex and furnished with a serie of emarginate verrucae, below the apex are also disposed the vertical series of similar verrucae but these series often less distinct than the apical series of verrucae, processes horizontal or incurved, tipped with 4 short spines, with a transverse serie of granules just above the isthmus; semicell in vertical view trigonal, sides slightly concave with 4 verrucae at the middle but median two are prominent, within the margin with an arched serie of verrucae on each side, central part of semicell smooth, angles produced into short attenuated and denticulated processes which are provided with 4 series of denticulations from base to top. Pl. 12, fig. 7, 8; Pl. 13, fig. 8.

Hab. 30, 40, 45, 57, 58, 61, 65, 74, 94, 104, 123, 516, 523. Distr. Alaska, Canada, and Europe.

Staurastrum brebissonii ARCH. in WEST & CARTER, Monogr. Br. Desm., **5**, p. 61, pl. 137, f. 4, 5, 1923; KRIEGER, Ber. dt. bot. Ges., **56**, p. 64, pl. 2, f. 1, 2, 1938.

Cells 35–37μ long, 37.5–39μ broad, and isthmus 13μ broad. The present specimens are distinguished from *St. pilosum* by bearing the long spines at the angles. Pl. 12, fig. 5.

Hab. 58. Distr. Alaska. Devon Island, U.S.A., Europe, Novaya Zemlya. Spitzbergen, Greenland, Patagonia and Antarctic.

Staurastrum brevispinum BRÉB. var. *boldtii* LAGERH. in SKUYA, Nova Acta R. Soc. Scient. upsal., ser. 4, **18**(3), p. 248, pl. 49, f. 10, 1964.

Cells 52–53μ long, 41–42μ broad, and isthmus 15–15.6μ broad. Pl. 10, fig. 10.

Hab. 118. Distr. Europe.

St. brevispinum var. *retusum* BORGE, Bih. K. Svenska. Vet.-Akad. Handl., **19**, Afd. 3, p. 36, pl. 3, f. 42, 1894.

Cells 46–46.5μ long, 37.4–38μ broad, and isthmus 13μ broad. Pl. 10, fig. 5.

Hab. 119. Distr. Europe.

Staurastrum capitulum BRÉB. var. *spetsbergense* (NORDST.) COOCKE in WEST & CARTER, Monogr. Br. Desm., **5**, p. 126, pl. 118, f. 8, 1923; KRIEGER, Ber. dt. bot. Ges., **56**, p. 64, pl. 2, f. 9, 10, 1938; CROASDALE, Trans. Am. microsc. Soc., **81**, p. 38, pl. 6, f. 119, 1962; FÖRSTER, Ark. Bot., ser. 2, **6**(3), p. 153, pl. 9, f. 13, 14; pl. 12, f. 12, 1965.

Cells 50–53μ long, 33–34.4μ broad, and isthmus 19–20μ broad. Pl. 11, fig. 6.

Hab. 94. Distr. Alaska, N. Europe, Spitzbergen, Novaya Zemlya and Brazil.

Staurastrum cristatum (NÄG.) ARCH. in WEST & CARTER, Monogr. Br. Desm., **5**, p. 47, pl. 139, f. 5, 1923; WHELDEN, Bull. natn. Mus. Can., **97**, p. 100, pl. 7, f, 7, 1947; CROASDALE, Trans. Am. micrsco. Soc., **81**, p. 38, pl. 7, f. 129, 1962.

Cells without spine 41–48μ long, 39.5–48μ broad, and isthmus 20–22μ broad.

Hab. 55, 74, 115, 121. Distr. Alaska, Greenland, Spitzbergen, Europe, Bornholm, Faeroes, Siberia, Japan and India.

Staurastrum cyrtocerum Bréb. in West & Carter, Monogr. Br. Desm., **5**, p. 135, pl. 149, f. 9; pl. 150, f. 4, 1923; Croasdale, Trans. Am. microsc. Soc., **76**, p. 143, pl. 6, f. 102, 103, 1957; *l.c.* **84**, p. 330, pl. 8, f. 11, 12, 1965.

Cells 33–37.5μ long, 35–39.6μ broad, and isthmus 8.7–13μ broad.

Hab. 40, 56, 57, 94, 121. Distr. Alaska, Devon Island, U.S.A., Europe, Spitzbergen, Bornholm, Japan, Australia and S. America.

Staurastrum dejectum Bréb. in West & Carter, Monogr. Br. Desm., **5**, p. 7, pl. 129, f. 9–12, 1923; Skuja, Nova Acta R. Soc. Scient. upsal., ser. 4, **18**(3), p. 249, pl. 49, f. 11, 1964.

Cells without spine 31–37.5μ long, 31–39.5μ broad, and isthmus 7.5–11μ broad.

Hab. 29, 61, 115, 530. Distr. Canada. U.S.A., Europe, Greenland, Iceland, Faeroes, Siberia, Japan, Mongolia, China, and E. Africa.

St. dejectum var. *inflatum* W. & G. S. West in West & Carter, Monogr. Br. Desm., **5**, p. 10, pl. 130, f. 3–5, 1923; Skuja, Nova Acta R. Soc. Scient. upsal., ser. 4, **18**(3), p. 249, pl. 50, f. 4, 1964.

Cells without spine 46–48.5μ long, 46–48.5μ broad, and isthmus 12–13μ broad.

Hab. 121. Distr. Europe.

Staurastrum dilatatum Ehrenb. in W. & G. S. West, Monogr. Br. Desm., **4**, p. 172, pl. 126, f. 10–15μ, 1911; Croasdale, Trans. Am. microsc. Soc., **76**, p. 143, pl. 4, f. 71, 1957; Förster, Ark. Bot., ser. 2, **6**(3), p. 154, pl. 8, f. 16, 1965.

Cells 26.5–28μ long, 26.5–28μ broad, and isthmus 8.7– 9.5μ broad.

Hab. 29. Distr. Alaska, Devon Island, Europe, Greenland, U.S.A., Japan, Africa, Madagascar, New Zealand and S. America.

Staurastrum ellipticum West, Monogr. Br. Desm., **4**, p. 138, pl. 119, f. 7, 1911.

Cells 42–44μ long, 32–33μ broad, and isthmus 13μ broad.

Hab. 203. Distr. Europe, Greenland and Paraguay.

Staurastrum forficulatum Lund. var. *verrucosum* Grönblad in Acta Soc. Fauna Flora fenn., **47**, p. 64, pl. 3, f. 47, 50, 51, 1920; Hirano, Contr. biol. Lab. Kyoto Univ., **9**, p. 333, pl. 42, f. 1, 1959.

Cells with process 48–52μ long, 38–40μ broad, and isthmus 14–15μ broad.

Hab. 104. Distr. Europe and Japan.

Staurastrum furcigerum Bréb. in West & Carter, Monogr. Br. Desm., **5**, p. 188,

pl. 156, f. 7, 8, 1923; FÖRSTER, Ark. Bot., ser. 2, **6**(3), p. 154, pl. 8, f. 29, 1965.

Cells with process 84–88μ long, 75–79μ broad, and isthmus 19–21μ broad.

Hab. 30, 57, 115. Distr. Alaska, Canada, U.S.A., Europe, Greenland, Siberia, Japan, Mongolia and Patagonia.

Staurastrum granulosum (EHRENB.) RALFS var. *acutum* (BRÉB.) W. & G. S. WEST, Monogr. Br. Desm., **4**, p. 190, pl. 128, f. 14, 1911.

Cells 31–33μ long, 28–31μ broad, and isthmus 9–9.5μ broad. Pl. 11, fig. 9.

Hab. 56. Distr. Europe.

Staurastrum gronbladii SKUJA in CROASDALE, Trans. Am. microsc. Soc., **76**, p. 144, pl. 4, f. 63, 64, 1957.

Cells 27.5-28μ long, 25–25.7μ broad, and isthmus 10.5–11μ broad. The present specimens resemble *St, orbiculare* var. *quadratum*, but differ from it by the form of sinus and less deep constriction. Pl. 11, fig. 12.

Hab. 538. Distr. Alaska and Europe.

Staurastrum insigne LUND. in Nova Acta R. Soc. Scient. upsal., ser. 3, **8**, p. 58, pl. 3, f. 25, 1871; CROASDALE, Trans. Am. microsc. Soc., **81**, p. 39, pl. 7, f. 123, 1962; FÖRSTER, Ark. Bot.. ser. 2, **6**(3), p. 154, pl. 8, f. 11; pl. 12, f. 14, 15, 1965.

Cells 27–29μ long, 22–22.6μ broad, and isthmus 11.5μ broad. Pl. 10, fig. 6.

Hab. 58. Distr. Europe.

Staurastrum johnsonii W. & G. S. WEST, Trans. Linn. Soc. Bot., **5**, p. 266, pl. 17, f. 16, 1896; CROASDALE, Trans. Am. microsc. Soc., **76**, p. 145, pl. 9, f. 126, 127, 1957.

Cells 58–61.6μ long, 94–96.8μ broad including process, and isthmus 14–16μ broad.

Hab. 115. Distr. Alaska and U.S.A.

Staurastrum lapponicum (SCHMIDLE) GRÖNBLAD in CROASDALE, Trans. Am. microsc. Soc., **83**, p. 204, pl. 18, f. 7, 8, 1964; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, **18**(3), p. 255, pl. 51, f. 10, 1964.

Cells 35–44μ long, 35–44μ broad, and isthmus 10–13μ broad.

Hab. 26, 40, 56, 61, 65, 115, 117, 119, 121. Distr. Europe and Japan.

Staurastrum lunatum RALFS in WEST & CARTER, Monogr. Br. Desm., **5**, p. 29, pl. 133, f. 17–19, 1923.

Cells 31–35μ long, 31–32.6μ broad, and isthmus 11–13μ broad. Pl. 11, fig. 10.

Hab. 93, 119, 123. Distr. Alaska, Europe, Faeroes, Greenland, Siberia and Japan.

St. lunatum var. *planctonicum* W. & G. S. WEST in WEST & CARTER, Monogr. Br. Desm., **5**, p. 30, pl. 133, f. 20–22, 1923; SKUYA, Nova Acta R. Soc. Scient. upsal., ser. 4, **18**(3), p. 253, pl. 51, f. 3, 4, 1964.

Cells 44–53μ long, 48.5–53μ broad, and isthmus 14.5–19μ broad. Pl. 12, fig. 2.

Hab. 65. Distr. Canada and Europe.

Staurastrum margaritaceum (EHRENB.) MENEGH. in WEST & CARTER, Monogr. Br. Desm., **5**, p. 131, pl. 150, f. 5–9, 1923; CROASDALE, Trans. Am. microsc. Soc., **76**, p. 145, pl. 6, f. 101, 1957.

Cell 22μ long, 22μ broad, and isthmus 8.7μ broad.

Hab. 16, 58, 115. Distr. Alaska, U.S.A., Europe, Greenland, Spitzbergen, Japan, India , Thailand, Celebes and Brazil.

Staurastrum megacanthum LUND. in GRÖNBLAD, Acta Soc. Fauna Flora fenn., **47**, p. 69, pl. 1, f. 41, 1920; WEST & CARTER, Monogr. Br. Desm., **5**, p. 20, pl. 131, f. 7, 8, 1923.

Cells without spine 54–57μ long, 56.5–59μ broad, and isthmus 12–13μ broad.

Hab. 61. Distr. U.S.A., Canada, Europe, Iceland, Japan, India, and Patagonia.

Staurastrum monticulosum BRÉB. in WEST & CARTER, Monogr. Br. Desm., **5**, p. 183, pl. 154, f. 8, 1923.

St. monticulosum var. *alaskanum* HIRANO, var. nov.

Semicellulae subfusiformes, marginibus lateralibus et apicibus convexis, angulis lateralibus cum spinis singulis longis robustis; in vertice visae lateribus retusis; processibus apicalibus prominentibus productis; in basi visae lateribus cum spinis brevibus variabilibus, long. sine proc. 37.4μ, cum proc. 44μ; lat. cum proc. 39.6μ, cum spin. 47.4μ; lat. isth. 10μ. Pl. 12, fig. 4.

Hab. 119.

The present variety differs from the typical form by having a single long and stout spine at each lateral angle as seen in the front view, and the sides in the vertical view are retuse in the middle. Apical processes are developed better than those of the typical form. There are short spines or denticulations on or within each lateral side as observed in basal view, but these spines are considerably varied among the specimens. The present form apparently resembles *St furcatum* var. *subsenarium*, but the lateral spines are single on each angle and do not pair vertically as seen in the latter species, and is distinguished from the latter by having a straight side in vertical view. LÜTKEMÜLLER reported *St. lunatum* forma *luxurians* from Bohemia and the present form is similar to that form, but he does not show the vertical view of forma *luxurians* in his paper.

Staurastrum mucronatum RALFS var. *subtriangulare* W. & G. S. WEST in WEST & CARTER, Monogr. Br. Desm., **5**, p. 12, pl. 130, f. 13, 14, 1923; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, **18**(3), p. 251, pl. 50, f. 10, 1964; FÖRSTER, Ark. Bot., ser. 2, **6**(3), p. 156, pl. 9, f. 21, 1965.

Cells 35–37μ long, 35–37μ broad, and isthmus 8.7–9μ broad. Apex of semicell convex and spines slightly short, sinus more open and obtuse at the extremity. Pl. 10, fig. 9.

Hab. 16, 56, 119. Distr. Europe, Burma and Japan.

Staurastrum muticum BRÉB. in W. & G. S. WEST, Monogr. Br. Desm., **4**, p. 133, pl. 118, f. 16–20, 1911; FÖRSTER, Ark. Bot., ser. 2, **6**(3), p. 156, pl. 8, f. 12, 1965.

Cells 26.5–29μ long, 26.5–29μ broad, and isthmus 8.7–10μ broad.

Hab. 119. Distr. Devon Island, U.S.A., Europe, Faeroes, Spitzbergen, Siberia, Japan, Mongolia, Java, Central Africa and Brazil.

Staurastrum orbiculare RALFS var. *depressum* ROY & BISS. in W. & G. S. WEST, Monogr. Br. Desm., **4**, p. 158, pl. 124, f. 17–19, 1911.

Cells 23–25μ long, 22–24μ broad, and isthmus 6.5–7μ broad.

Hab. 55. Distr. Alaska, Europe, Japan, China, Thailand, Australia, New Zealand and Madagascar.

St. orbiculare var. *ralfsii* W. & G. S. WEST in Monogr. Br. Desm., **4**, p. 156, pl. 124, f. 12, 13, 15, 16, 1911.

Cells 34–35μ long, 33–33.5μ broad, and isthmus 9–10μ broad.

Hab. 29, 56. Distr. Alaska, Europe, Spitzbergen, Greenland, Bornholm, Novaya Zemlya, India and Australia.

Staurastrum oxyacanthum ARCH. in WEST & CARTER, Monogr. Br. Desm., **5**, p. 169, pl. 143, f. 18, 19, 1923.

St. oxyacanthum var. *croasdaleae* HIRANO, var. nov.

Semicellulae cyathiformes, marginibus ventralibus tumidis, apice convexo, angulis apicalibus productis in processus longos denticulatos leviter convergentes et attenuatos apicibus acute 4-spinatis; in vertice visae tetragonae, lateribus leviter concavis cum spinis longis duobus juxta infra marginem, angulis productis in processus longos 4 denticulatos leviter attenuatos, spice processuum 4 spinato, 39–40μ long., 52–53μ lat., 11μ lat. isth. Pl. 12, fig. 1.

Hab. 115.

St. oxyacanthum var. *sibiricum* BOLDT in Öfv. K. Vet.-Akad. Förh., no. 2, p. 119, pl. 6, f. 40, 41, 1885; BORGE, Ark. Bot., **6**(1), p. 48, pl. 3, f. 40, 1906.

Cells 34–35μ long, 33–35μ broad, and isthmus 10μ broad. Pl. 13, fig. 4.

Hab. 56. Distr. Europe and Siberia.

Staurastrum pachyrhynchum NORDST. in W. & G. S. WEST, Monogr. Br. Desm., **4**, p. 151, pl. 121, f. 8, 9, 1911.

Cells 42–44μ long, 40–43μ broad, and isthmus 13–14μ broad. Pl. 11, fig. 5.

Hab. 55. Distr. U.S.A., Europe, Greenland, Spitzbergen, Novaya Zemlya, Siberia and Japan.

St. pachyrhynchum forma *kossinskayae* CROASDALE in Trans. Am. microsc. Soc., **81**, p. 39, pl. 7, f. 122, 1962.

Cells 45–46μ long, 47–48.5μ broad, and isthmus 13μ broad. Pl. 11, fig. 4.

Hab. 55. Distr. Alaska.

Staurastrum pendulum NYGAARD var. *pinguiforme* CROASDALE in Trans. Am. microsc. Soc., **77**, p. 31, f. 2, 1958.

Cells 35μ long, 48–48.5μ broad with process, and isthmus 13μ broad. Semicells cup-shaped, sinus shallow but acuminate, apex slightly convex, angles produced into long, slender, horizontal, attenuated processes which terminate with 3 minute spines; in vertical view of semicell 3-angular, side slightly concave, angles produced into slender attenuated processes, with a delicate series of emarginate verrucae within each margin. Pl. 12, fig. 10.

Hab. 22, 29, 55, 56, 116. Distr. Alaska.

Staurastrum petsamoense (BOLDT) JÄRNEFELT in THOMASSON, Bot. Notiser., **110**, p. 254, f. 2, 1957; SKUJA, Nova Acta R. Soc. Scient. upsal. ser. 4, **18**(3), p. 262, pl. 53, f. 1–3, 1964.

Cells 48–49μ long, 78–80μ broad with process, and isthmus 15–15.5μ broad. The present specimens have slightly longer processes and also the number of denticulations is larger than those of North European forms. Each side of semicell in the vertical view is concave and slightly undulated and with a series of verrucae within each margin. Pl. 13, fig. 1–3, 6.

Hab. 29, 57, 115. Distr. North Europe.

St. petsamoense var. *minus* THOMASSON in Bot. Notiser, **110**, p. 254, f. 3, 1957.

Cells 39–40μ long, 48.5–53μ broad with process, and isthmus 13–15μ broad. In the specimens obtained from the place of no. 538, the processes are short, robust, horizontal, and 5 denticulated; semicells without a transverse series of denticulations above the isthmus; side of cell in the vertical view almost straight and the undulation is not distinct, sometimes with a series of 4 verrucae within the margin. Pl. 12, fig. 9; Pl. 13, fig. 9.

Hab. 45, 123, 530, 538. Distr. North Europe.

Staurastrum pilosum (NÄG.) ARCH. in WEST & CARTER, Monogr. Br. Desm., **5**, p. 63, pl. 138, f. 1–3, 1923; FÖRSTER, Ark. Bot., ser. 2, **6**(3), p. 156, pl. 8, f. 23, 1965.

Cells 40–57μ long, 41.7–61.5μ broad, and isthmus 13–14μ broad.

Hab. 57, 65, 72, 74, 76, 104, 536. Distr. Europe, Greenland, Spitzbergen, Faeroes, Iceland and Siberia.

Staurastrum polymorphum BRÉB. in WEST & CARTER, Monogr. Br. Desm., **5**, p. 125, pl. 142, f. 24; pl. 143, f. 1-3, 1923; CROASDALE, Trans. Am. microsc. Soc., **76**, p. 147, pl. 6, f. 99, 100, 1957; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, **18**(3), p. 260, pl. 52, f. 11, 1964.

Cells 26.5–27μ long, 24.5–31μ broad with process, and isthmus 7–8.8μ broad.

Hab. 15, 29, 61, 74, 123, 203. Distr. U.S.A., Alaska, Canada, Europe, Spitzbergen, Greenland, Novaya Zemlya, Faeroes, Siberia and Japan.

Staurastrum polytrichum (PERTY) RABENH. in WEST & CARTER, Monogr. Br. Desm., **5**, p. 53, pl. 136, f. 8–10, 1923; CROASDALE, Trans. Am. microsc. Soc., **81**, p. 39, pl. 7, f. 130, 1962.

Cells without spine 59.5–88μ long, 57–70μ broad, and isthmus 22–24μ broad.

Hab. 74, 119, 203. Distr. U.S.A., Canada, Alaska, Europe, India and S. America.

Staurastrum punctulatum BRÉB. in W. & G. S. WEST, Monogr, Br. Desm., **4**, p. 179, pl. 127, f. 8–11, 13, 14, 1911; CROASDALE, Trans. Am. microsc. Soc., **76**, p. 148, pl. 4, f. 74, 1957; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, **18**(3), p. 254, pl. 51, f. 2, 1964.

Cells 40.5–48.4μ long, 40.5–44μ broad, and isthmus 13–14.5μ broad. The present specimens coincide well with the Alaskan forms reported by CROASDALE. The apex of semicell is less convex than that of the British form figured by WEST, and sinus is acuminate at the extremity. The specimens in which the collection was made in a place of no. 173 coincide with figure 73 given by CROASDALE, and its cell form apparently resembles var. *kjellmani* of this species, and the side of cell in the vertical view is straight or faintly convex and never shows retuseness. Angles of semicell are broadly rounded and do not coincide with the acute angles of typical form, so that the present specimens will be related rather to the following var. *kjellmani*.

Hab. 169, 536, 538. Distr. Alaska. Canada, U.S.A., Europe, Spitzbergen, Greenland, Iceland, Bornholm, Japan, India, Java, Australia and S. America.

St. punctulatum var. *kjellmani* WILLE in W. & G. S. WEST, Monogr. Br. Desm., **4**, p. 182, pl. 127, f. 13, 17–19, 21, 22, 1911; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, **18**(3), p. 254, 1964; CROASDALE, Trans. Am. microsc. Soc., **84**, p. 332, pl. 7, f. 21, 22, 1965.

Cells 44–53μ long, 39.6–44μ broad, and isthmus 13–22μ broad. The specimens collected from no. 22 bear hexagonal semicell, its apex is straight, and the series of granules are distinct. This form is similar to *St. hexagonale* FRITSCH described from Africa, but is distinguished by larger size of cell. The specimens collected from the place of no. 203 are quadrangular in form and the side in vertical view is slightly retuse, while those collected from no. 173 are triangular.

Hab. 22, 30, 72, 172, 173, 203, 223, 513. Distr. Devon Island, Europe, Novaya Zemlya, Spitzbergen, Greenland, Faeroes and Japan.

St. punctulatum var. *muricatiforme* SCHMIDLE in W. & G. S. WEST, Monogr. Br. Desm., **4**, p. 186, 1911.—*St. muricatiforme* SCHMIDLE in Öst. bot. Z., p. 162, pl. 16, f. 14, 15, 1896.

Cells 44μ long, 39.6μ broad, and isthmus 13μ broad. Semicells are more depressed than those of the typical form, and the sinus is more acute and slightly open. Angles of semicell are broadly rounded. The sides of semicell in vertical view are retuse. Pl. 11, fig. 3.

Hab. 28. Distr. Europe.

Staurastrum sebaldi REINSCH var. *impar* CROASDALE in Trans. Am. microsc. Soc., **77**, p. 32, f. 3, 1958.

Cells with process 58–61μ long, 70–74.5μ broad, and isthmus 12–13μ broad. The specimens coincide well with the form reported from Kodiak, Alaska. Semicells tetragonal, angles produced into about 7 denticulated slightly attenuated stout process, base of processes with a pair of fairly long spines, in vertical view of semicell sides with a serie of three verrucae within each margin.

Hab. 119. Distr. Alaska.

Staurastrum senarium (EHRENB.) RALFS var. *nigrae*-silvae SCHMIDLE, Ber. dt. bot. Ges., **11**, p. 553, pl. 28, f. 19, 1893.

Cells with process 44–48μ long, 40–53μ broad, and isthmus 13–15μ broad. Pl. 13, fig. 5.

Hab. 29, 56. Distr. Europe.

Staurastrum sibiricum BORGE in Bih. K. Svenska Vetensk-Akad. Handl., **17**, Afd. 3, no. 2, p. 9, f. 4, 1891.

Cell 22μ long, 21μ broad, and isthmus 8.7μ broad. Semicells obversely semicircular, lateral margin slightly convex, apex almost straight or slightly retuse and angles obtuse, sinus subrectangular but acuminate at the extremity. GRÖNBLAD reported *C. capitulum* var. *gronlandicum* BÖRGES. but the present specimens differ from the latter by the slightly larger size. Pl. 12, fig. 3.

Hab. 123. Distr. Siberia.

Staurastrum subavicula W. & G. S. WEST in WEST & CARTER, Monogr. Br. Desm., **5**, p. 181, pl. 155, f. 10, 1923; CROASDALE & GRÖNBLAD, Trans. Am. microsc. Soc., **83**, p. 205, pl. 21, f. 5, 6, 1964.

Cells without spine 37–39.6μ long, 37–39μ broad, and isthmus 10–11μ broad.

Hab. 16. Distr. Canada, Europe and Australia.

Staurastrum teliferum RALFS in WEST & CARTER, Monogr. Br. Desm., **5**, p. 58, pl.

136, f. 2-6, 1923.

Cells 42-44μ long, 42-44μ broad, and isthmus 11μ broad.

Hab. 56. Distr. U.S.A., Canada, Europe, Iceland, Faeroes, Greenland, Siberia, Japan, Burma and Brazil.

Staurastrum varians RACIB. in CROASDALE & GRÖNBLAD, Trans. Am. microsc. Soc., **83**, p. 206, pl. 18, f. 9, 10, 1964.

Cell 35μ long, 39.5μ broad, and isthmus 16μ broad.

Hab. 22. Distr. Canada and Devon Island.

Staurastrum vestitum RALFS in WEST & CARTER, Monogr. Br. Desm., **5**, p. 158, pl. 151, f. 9-11; pl. 152, f. 5, 6, 1923; CROASDALE, Trans. Am. microsc. Soc., **76**, p. 150, pl. 8, f. 118, 119, 1957.

Cells 40-41μ long, 84-87μ broad with process, and isthmus 8μ broad.

Hab. 29. Distr. Alaska, U.S.A., Canada, Europe, Bornholm, Japan, Australia and Brazil.

Hyalotheca dissiliens (SM.) BRÉB. in WEST & CARTER, Monogr. Br. Desm., **5**, p. 229, pl. 161, f. 16-27, 1923; CROASDALE, Trans. Am. microsc. Soc., **76**, p. 152, pl. 10, f. 140, 141, 1957.

Cells 15.4-19.8μ long, 26.4-35μ broad, and isthmus 23-24μ broad.

Hab. 64, 121, 536. Distr. Cosmopolitan.

Hyalotheca mucosa (MERT.) EHRENB. in WEST & CARTER, Monogr. Br. Desm., **5**, p. 235, pl. 162, f. 1-4, 1923; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, **18**(3), p. 277, pl. 58, f. 12, 1964.

Cells 16.3-22μ long, 15.4-22μ broad.

Hab. 118, 121, 123. Distr. Alaska, Canada, U.S.A., Europe, Japan, India, Australia, Africa and Brazil.

Desmidium aptogonum BRÉB. in WEST & CARTER, Monogr. Br. Desm., **5**, p. 242, pl. 164, f. 1-3, 1923; CROASDALE, Trans. Am. Microsc. Soc., **76**, p. 152, pl. 10, f. 145, 146, 1957; SKUJA, Nova Acta R. Soc. Scient. upsal., ser. 4, **18**(3), p. 278, pl. 59, f. 5, 1964.

Cells 20-22μ long, 32-35μ broad, and isthmus 25-25.3μ broad.

Hab. 121. Distr. Alaska, U.S.A., Europe, Japan, India, Ceylon, Burma, Australia and Madagascar.

Desmidium baileyi (RALFS) NORDST. in CROASDALE, Trans. Am. microsc. Soc., **76**, p. 153, pl. 10, f. 149, 150, 1957.

Cells 23-26.5μ long, 22-25μ broad.

Hab. 116, 121. Distr. Alaska, Europe and Japan.

Desmidium swartzii Ag. in West & Carter, Monogr. Br. Desm., **5**, p. 246, pl. 163, f. 5–8, 1923.

Cells 19–20μ long, 43–44μ broad, and isthmus 38μ broad.

Hab. 117. Distr. Cosmopolitan.

Plate 1

1. *Cosmarium speciosum* LUND. p. 30
2. *C. speciosum* var. *rostaffinskii* (GUTW.) W. & G. S. WEST forma *americana* W. & G. S. WEST p. 31
3. *C. boeckii* WILLE p. 15
4. *C. hornavanense* GUTW. var. *dubovianum* (LÜTKEM.) RUZ. p. 23
5. *Closterium striolatum* EHRENB. var. *rectum* W. WEST p. 10

6-7. *Cl. elenkinii* KOSSINSKAJA p. 8

8. *Cl. arcuarium* HUGHES p. 6
9. *Cl. pseudolunula* BORGE p. 10
10. *Cl. acerosum* (SCHRANK) EHRENB. var. *porosum* HIRANO, sp. nov. p. 6

1-4 : × ca. 650 ; 9 : × 350 ; 5-8, 10 : × ca. 500

Plate 1

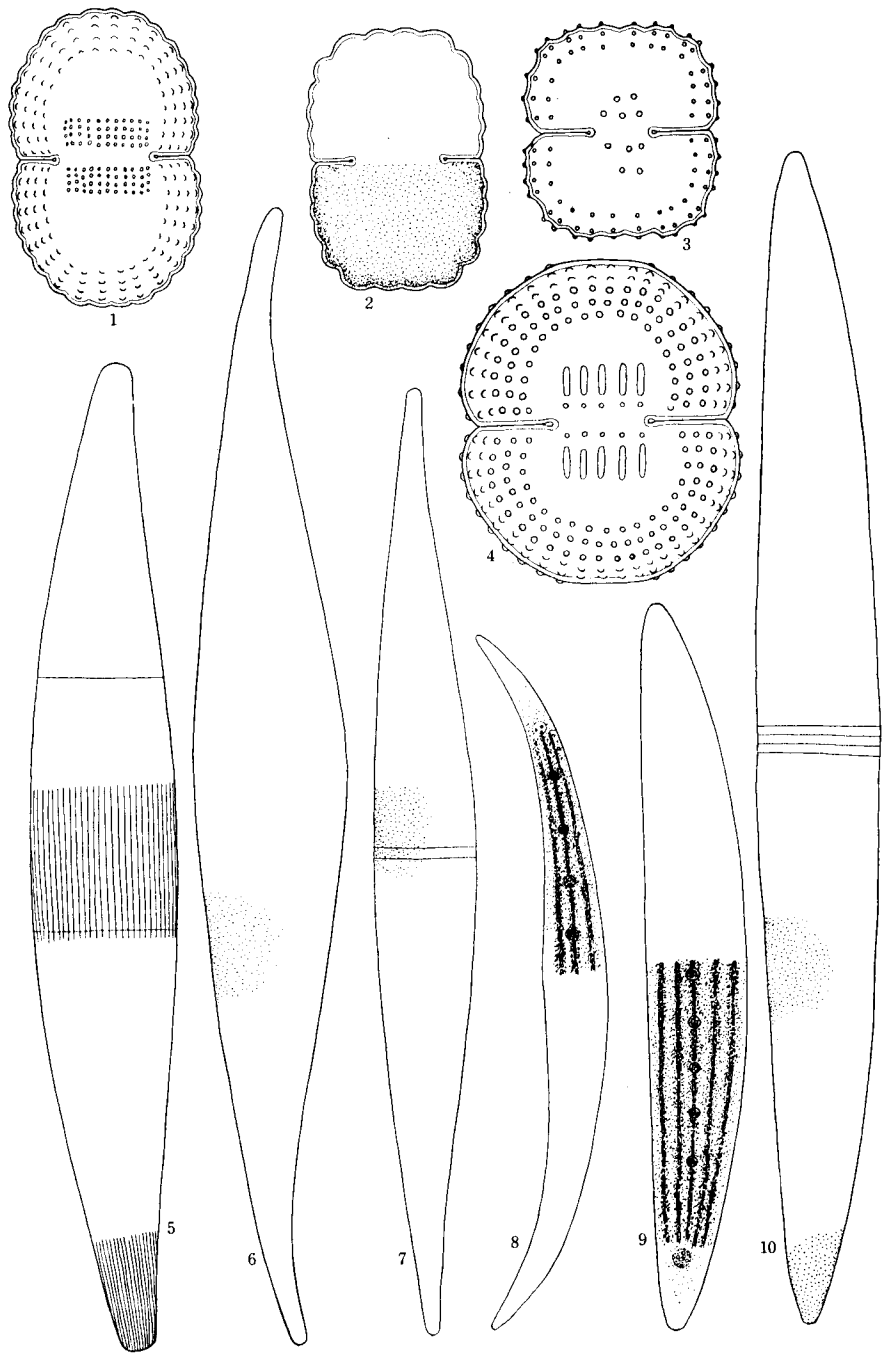

Plate 2

1. *Closterium didymotocum* RALFS p. 8
2. *Cosmarium tetragonum* NÄG. var. *heterocrenatum* W. & G. S. WEST p. 35
3. *Closterium acerosum* (SCHRANK) EHRENB. var. *nasutum* HIRANO, var. nov. p. 6
4. *Cl. costatum* CORDA var. *subcostatum* (NORDST.) KRIEGER p. 7
5. *Pleurotaenium truncatum* (BRÉB.) NÄG. p. 11
6. *Pl. truncatum* var. *crassum* BOLDT p. 11
7. *Cosmarium arctoum* NORDST. p. 13
8–9. *Pleurotaenium trabecula* (EHRENB.) NÄG. var. *crassum* WITTR. p. 11
10. *Pl. trabecula* (EHRENB.) NÄG. p. 11
11. *Pl. trabecula* var. *elongatum* CEDERGREN p. 11

1, 3-6, 8-11 : × ca. 500 ; 2, 7 : × ca. 800

Plate 2

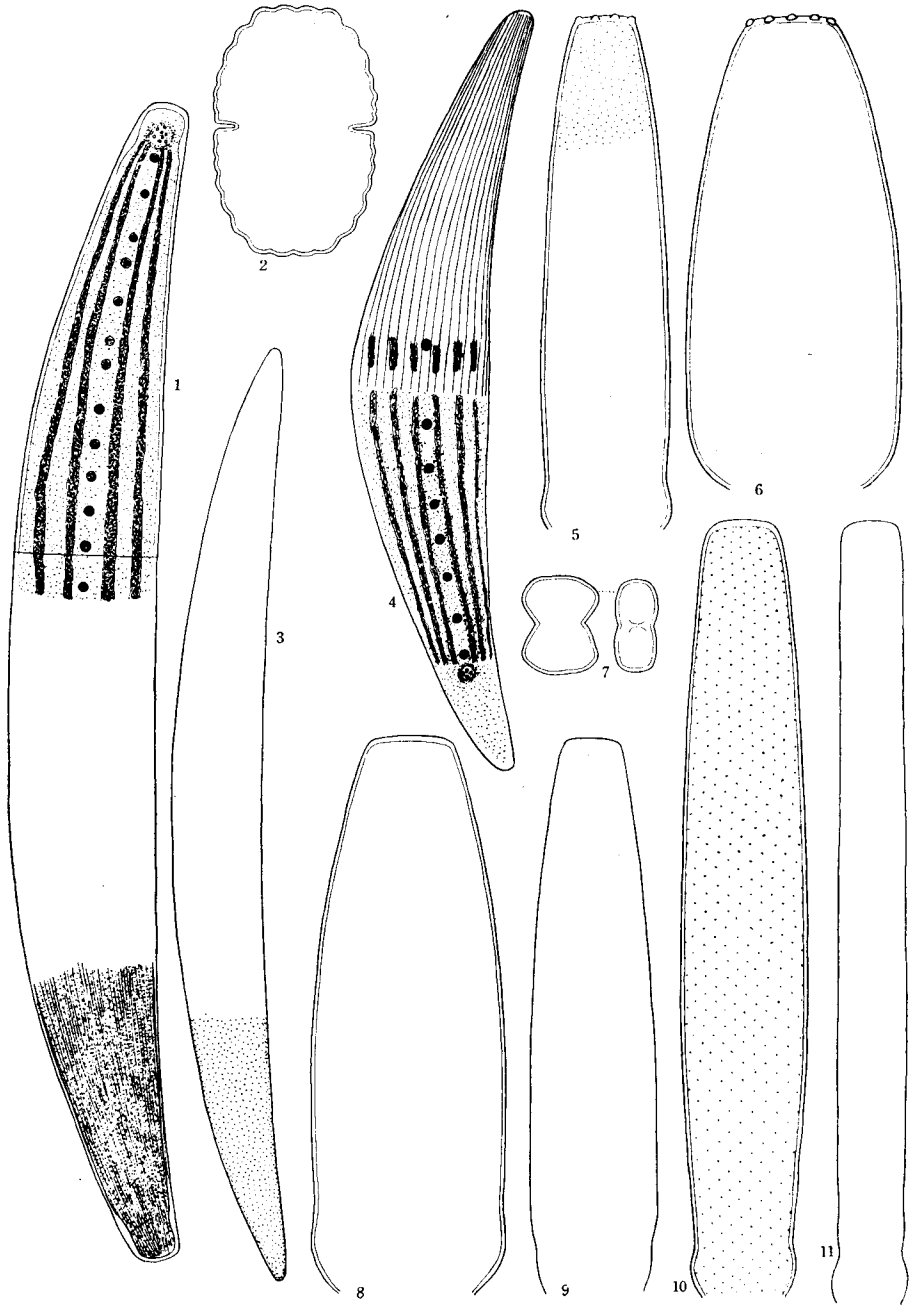

Plate 3

1. *Cosmarium pokornyanum* (GRUN.) W. & G. S. WEST p. 26
2. *C. difficile* LÜTKEM. p. 20
3. *C. phaseolus* BRÉB. var. *elevatum* NORDST. p. 26

4-5. *C. tumidum* LUND. p. 35

6. *C. quadratum* RALFS p. 29
7. *C. cucurbitinum* (BISS.) LÜTKEM. forma *minor* (WEST) LÜTKEM. p. 18
8. *C. subglobosum* NORDST. p. 32
9. *C. hammeri* REINSCH var. *homalodermum* (NORDST.) W. & G. S. WEST p. 22
10. *C. microsphinctum* NORDST. p. 25
11. *C. subcucumis* SCHMIDLE p. 32
12. *C. quadratum* RALFS p. 29
13. *C. subcucumis* SCHMIDLE p. 32
14. *C. wollei* (W. & G. S. WEST) GRÖNBLAD p. 37
15. *C. diplosporum* (LUND.) LÜTKEM. var. *americanum* (W. & G. S. WEST) HIRANO, comb. nov. p. 20
16. *C. debaryi* ARCH. var. *novae-semliae* WILLE p. 19

1-16 : × ca. 650

Plate 3

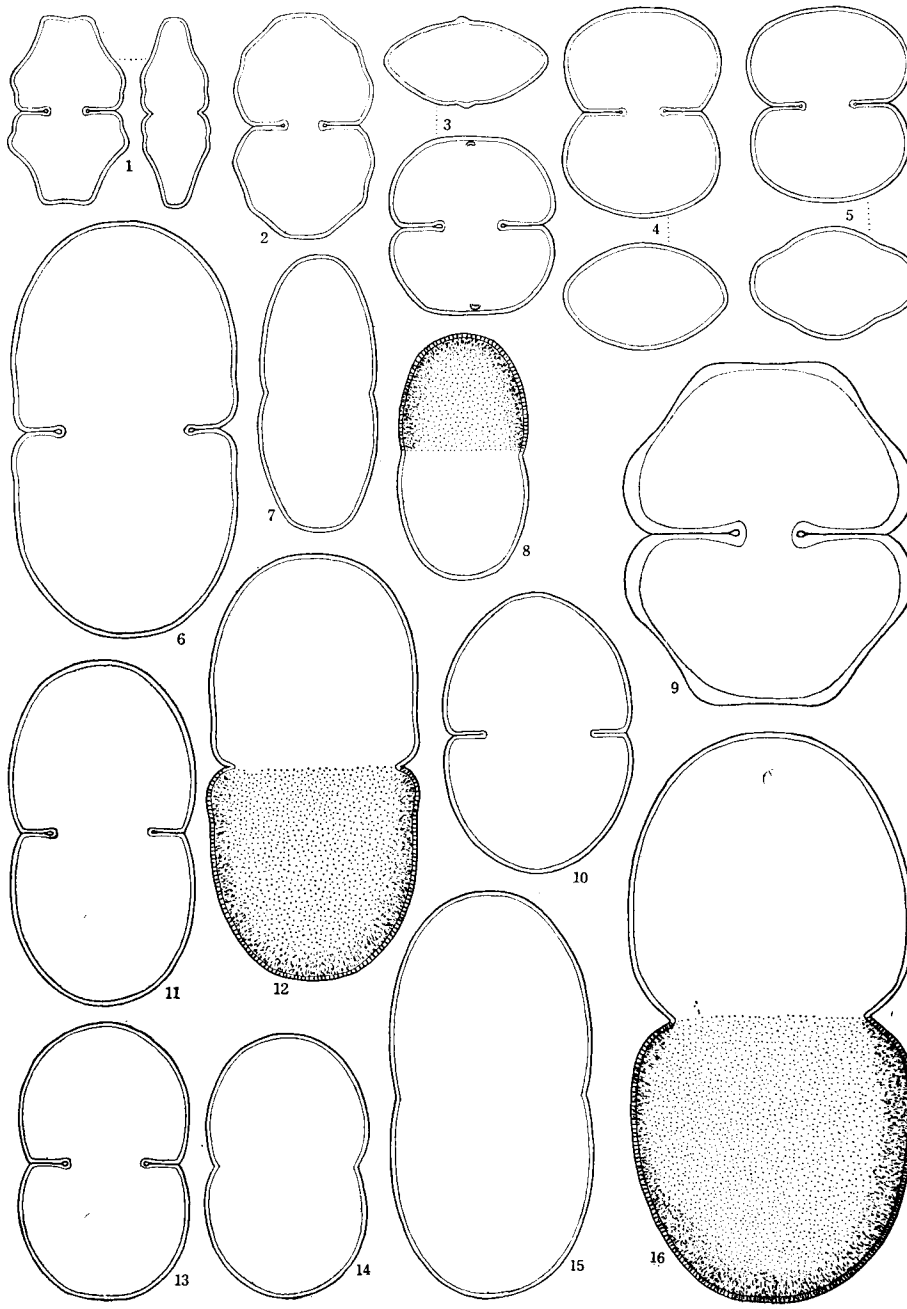

Plate 4

1. *Cosmarium decedens* (Reinsch) Racib. var. *borgei* Krieger p. 19
2. *C. undulatum* Corda var. *alaskanum* Croasdale forma *reductum* Croasdale p. 36
3. *C. difficile* Lütkem. var. *sublaeve* Lütkem. p. 20
4. *C. quadratulum* (Gay) De Toni p. 29
5. *C. bioculatum* Bréb. var. *borgei* Hirano, var. nov. p. 14
6. *C. pseudoprotuberans* Kirchn. var. *angustius* Nordst. p. 28
7. *C. humile* (Gay) Nordst. var. *striatum* (Boldt) Schmidle p. 23
8. *C. cymatonotophorum* West p. 19
9. *C. pseudoprotuberans* Kirchn. var. *pygmaeum* Gutw. p. 28
10. *C. borgesenii* Grönblad p. 15
11. *C. subtumidum* Nordst. var. *rotundum* Hirano p. 34
12. *C. impressulum* Elfv. p. 23
13. *C. subarctoum* (Lagerh.) Racib. p. 31
14. *C. cucumis* Corda p. 18
15. *C. curtum* (Bréb.) Ralfs p. 18
16. *C. pseudonitidulum* Nordst. var. *validum* W. & G. S. West p. 27
17. *C. subtumidum* Nordst. var. *gronbladii* Croasdale p. 34
18. *C. phaseolus* Bréb. var. *elevatum* Nordst. p. 26
19. *C. subundulatum* Wille p. 34
20. *C. phaseolus* Bréb. var. *achondrum* Boldt p. 26
21. *C. pachydermum* Lund. var. *alaskense* Hirano, var. nov. p. 25
22. *C. incertum* Schmidle var. *gronlandicum* (Boldt) Gutw. p. 23

1-22 : × ca. 650

Plate 4

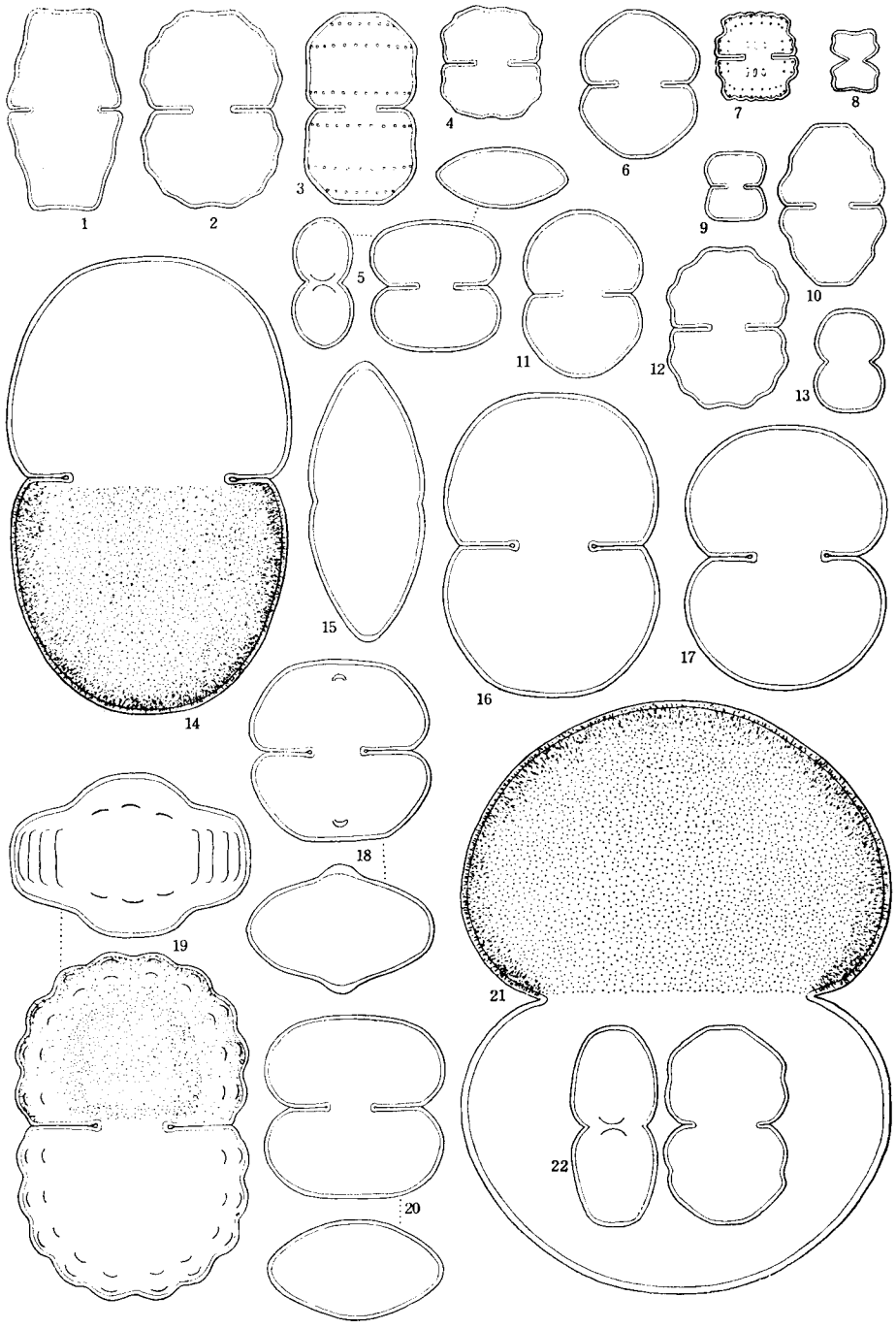

Plate 5

1. *Cosmarium canadense* IRENÉE-MARIE p. 16
2. *C. quadratum* RALFS var. *divergens* HIRANO, var. nov. p. 29
3. *C. granatum* BRÉB. var. *elongatum* NORDST. p. 21
4. *C. curtum* (BRÉB.) RALFS var. *obtusum* (W. & G. S. WEST) HIRANO, comb. nov. p. 18
5. *C. granatum* BRÉB. var. *subgranatum* NORDST. p. 21
6. *C. granatum* BRÉB. p. 21
7. *C. holmiense* LUND. var. *integrum* LUND. p. 22
8. *C. anceps* LUND. forma *subparvula* LARSEN p. 13
9. *C. borgesenii* GRÖNBLAD p. 15

10–13. *C. pseudoprotuberans* KIRCHN. forma *minus* KOSSINSKAJA p. 27

14. *C. granatum* BRÉB. var. *concavum* LAGERH. p. 21
15. *C. pseudoprotuberans* KIRCHN. var. *alpinum* RACIB. p. 27
16. *C. pseudoprotuberans* forma *minus* KOSSINSKAJA p. 27
17. *C. anceps* LUND. p. 12

18–19. *C. anceps* forma *subparvula* LARSEN p. 13

20–21. *C. anceps* forma *crispula* NORDST. p. 13

22. *C. abbreviatum* RACIB. var. *planctonicum* W. & G. S. WEST p. 12
23. *C. simplicius* (W. & G. S. WEST) GRÖNBLAD p. 30
24. *C. speciosissimum* SCHMIDLE p. 30
25. *C. subspeciosum* NORDST. p. 33
26. *C. supraspeciosum* WOLLE p. 34
27. *Arthrodesmus ralfsii* W. WEST p. 37

1–27 : × ca. 650

Plate 5

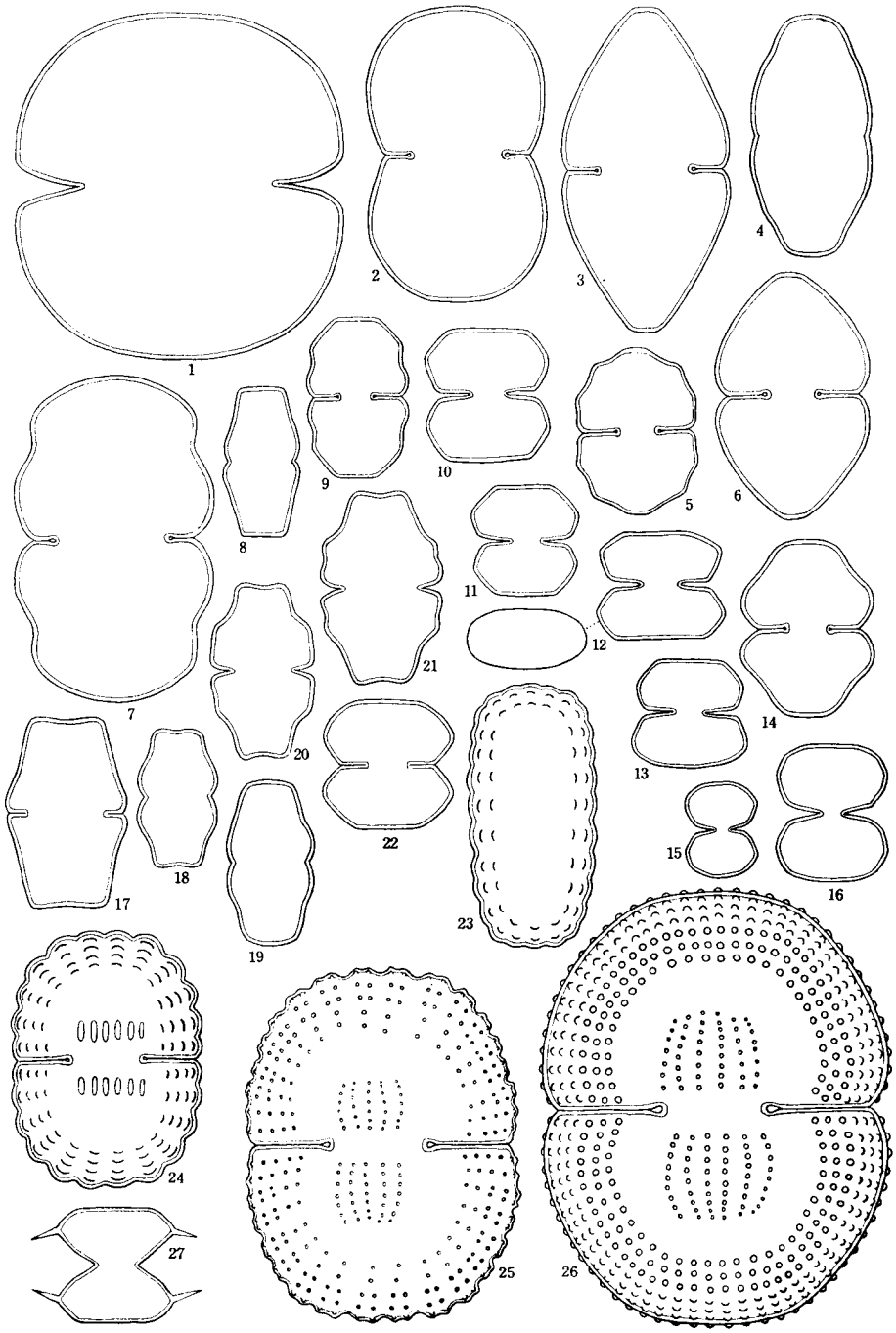

Plate 6

1. *Cosmarium subcostatum* NORDST. p. 31
2. *C. isthmochondrum* NORDST. var. *decussiferum* (BORGE) CROASDALE p. 23
3. *C. subcostatum* NORDST. var. *beckii* (GUTW.) W. & G. S. WEST p. 32
4. *C. protumidum* NORDST. p. 27
5. *C. tatricum* RACIB. forma *minor* MESSIK. p. 35
6. *C. biclavatum* BORGE var. *alaskanum* HIRANO, var. nov. p. 14
7. *C. depressum* (NÄG.) LUND. var. *planctonicum* REV. p. 19
8. *C. conspersum* RALFS var. *latum* (BRÉB.) W. & G. S. WEST p. 16
9. *C. protumidum* NORDST. p. 27
10. *C. kjellmani* WILLE var. *grande* WILLE p. 24
11. *C. subcostatum* NORDST. var. *spetsbergense* BORGE p. 32
12. *C. sexnotatum* GUTW. p. 30
13. *C. botrytis* MENEGH. var. *mesoleium* NORDST. p. 15
14. *C. punctulatum* BRÉB. var. *subpunctulatum* (NORDST.) BÖRGES. p. 28
15. *C. subochthodes* SCHMIDLE var. *scrobiculatum* (MESSIK.) CROAS. p. 33
16. *C. crenatum* RALFS p. 17
17. *C. crenatum* var. *bicrenatum* NORDST. p. 17

1–17 : × ca. 650

Plate 6

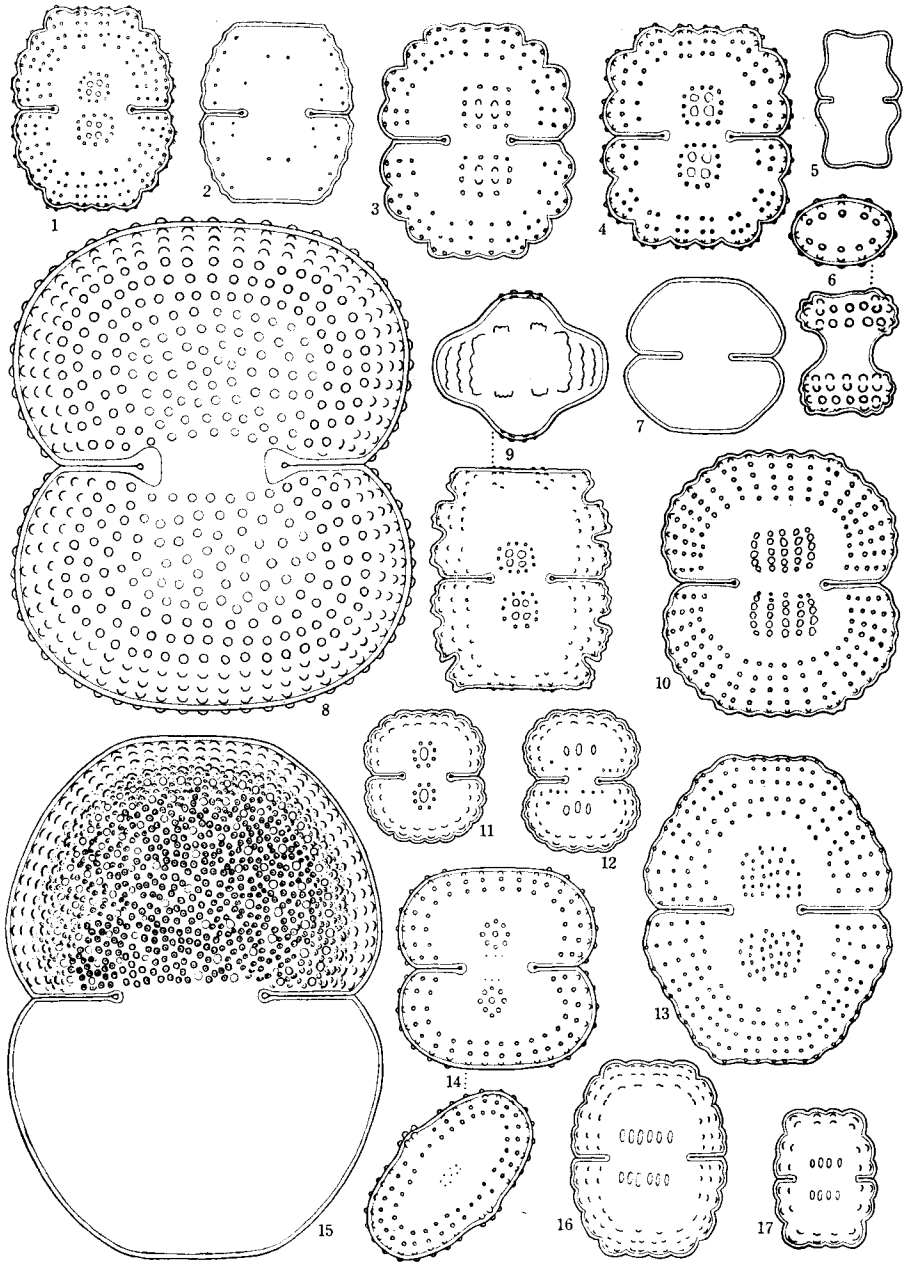

Plate 7

1. *Cosmarium margaritatum* (LUND.) ROY & BISS. var. *rotundatum* HIRANO, var. nov. p. 24
2. *C. costatum* NORDST. p. 16
3. *C. speciosissimum* SCHMIDLE var. *arcticum* HIRANO, var. nov. p. 30
4. *C. costatum* NORDST. forma *minor* BOLDT p. 17
5. *C. botrytis* MENEGH. p. 15

6–7. *C. tuddalense* STRÖM p. 35

8. *C. costatum* NORDST. var. *subhexalobum* BOLDT p. 17

1–8 : × ca. 650

Plate 7

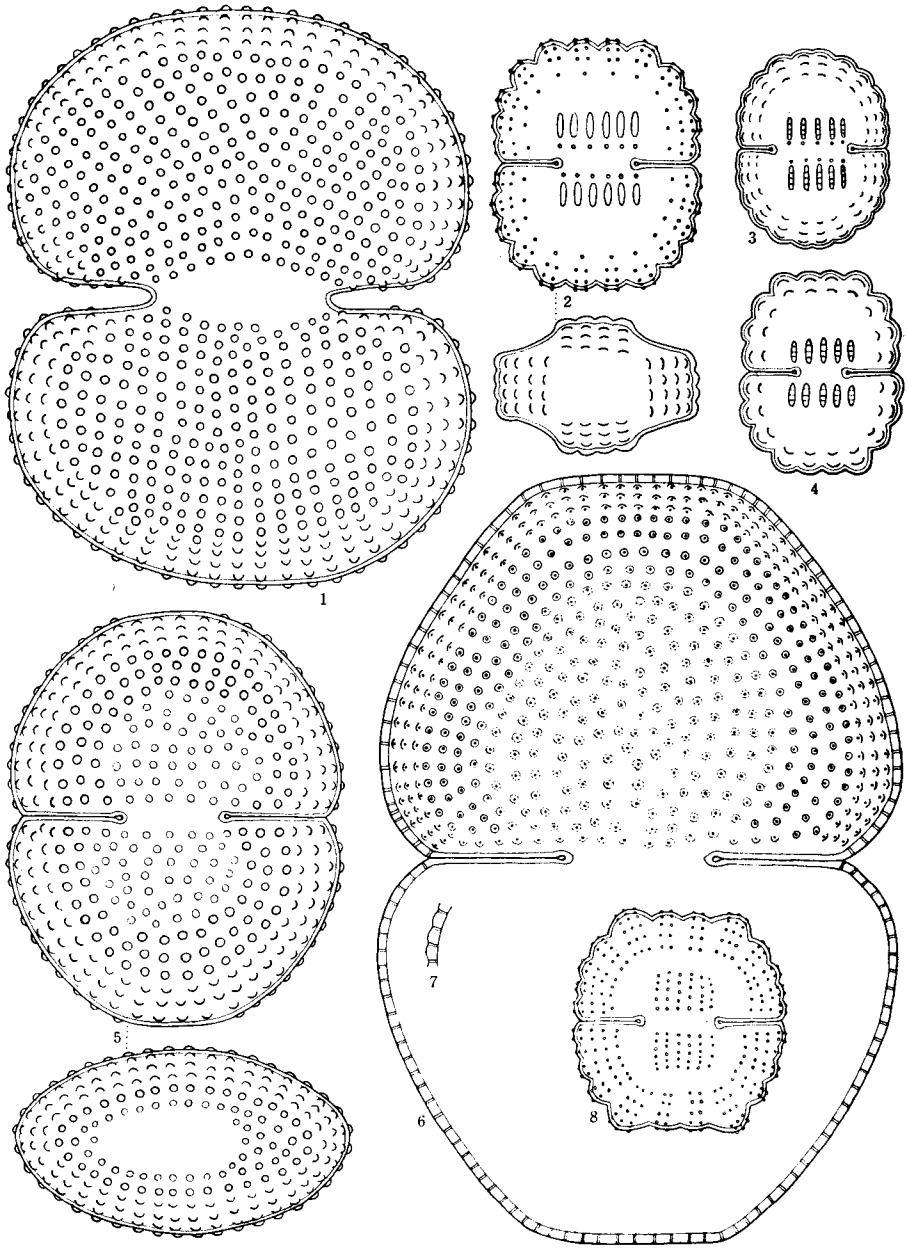

Plate 8

1. *Cosmarium latifrons* LUND. p. 24
2. *C. hians* BORGE p. 22
3. *C. hexalobum* NORDST. var. *laticeps* GRÖNBLAD p. 22
4. *C. woronichinii* KOSSINSKAJA p. 37
5. *C. turpinii* BRÉB. var. *eximium* W. & G. S. WEST p. 36
6. *C. amoeviforme* HIRANO var. *angustatum* HIRANO, var. nov. p. 12
7. *C. amoeviforme* HIRANO, sp. nov. p. 12
8. *C. vexatum* WEST var. *lacustre* MESSIK. p. 37
9. *C. cyclicum* LUND. var. *arcticum* NORDST. p. 18

1-9 : × ca. 650

Plate 8

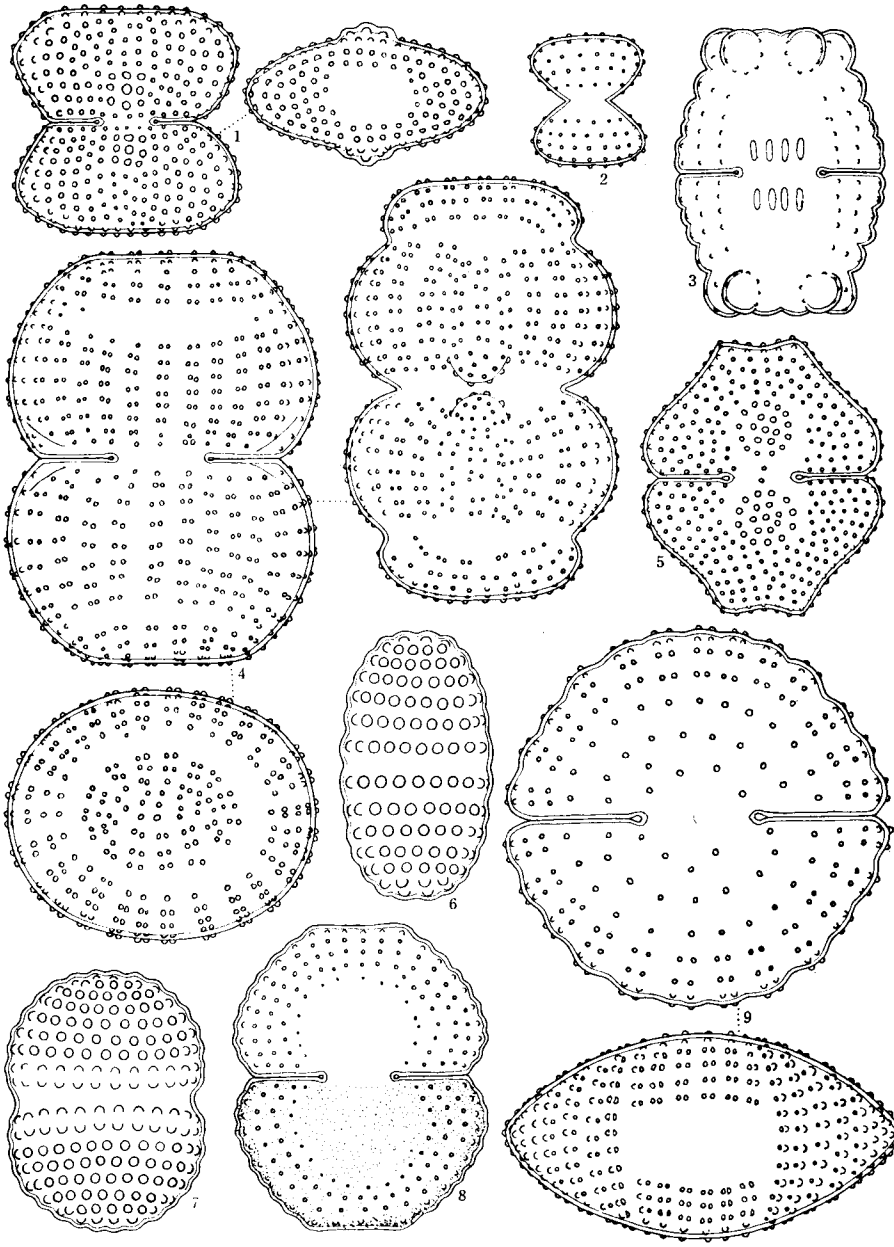

Plate 9

1. *Cosmarium botrytis* MENEGH. var. *tumidum* WOLLE p. 16
2. *C. botrytis* var. *gemmiferum* (BRÉB.) NORDST. p. 15
3. *C. subcrenatum* HANTZ. p. 32
4. *C. praemorsum* BRÉB. p. 26
5. *C. hornavanense* GUTW. forma *arcticum* CROASDALE p. 22
6. *C. formosulum* HOFF. p. 20
7. *C. biretum* BRÉB. var. *minus* HANSG. p. 14
8. *C. subspeciosum* NORDST. var. *transiens* MESSIK. p. 33
9. *C. speciosum* LUND. var. *simplex* NORDST. p. 31
10. *C. hornavanense* GUTW. p. 22
11. *C. subquasillus* BOLDT p. 33

1–11 : × ca. 650

Plate 9

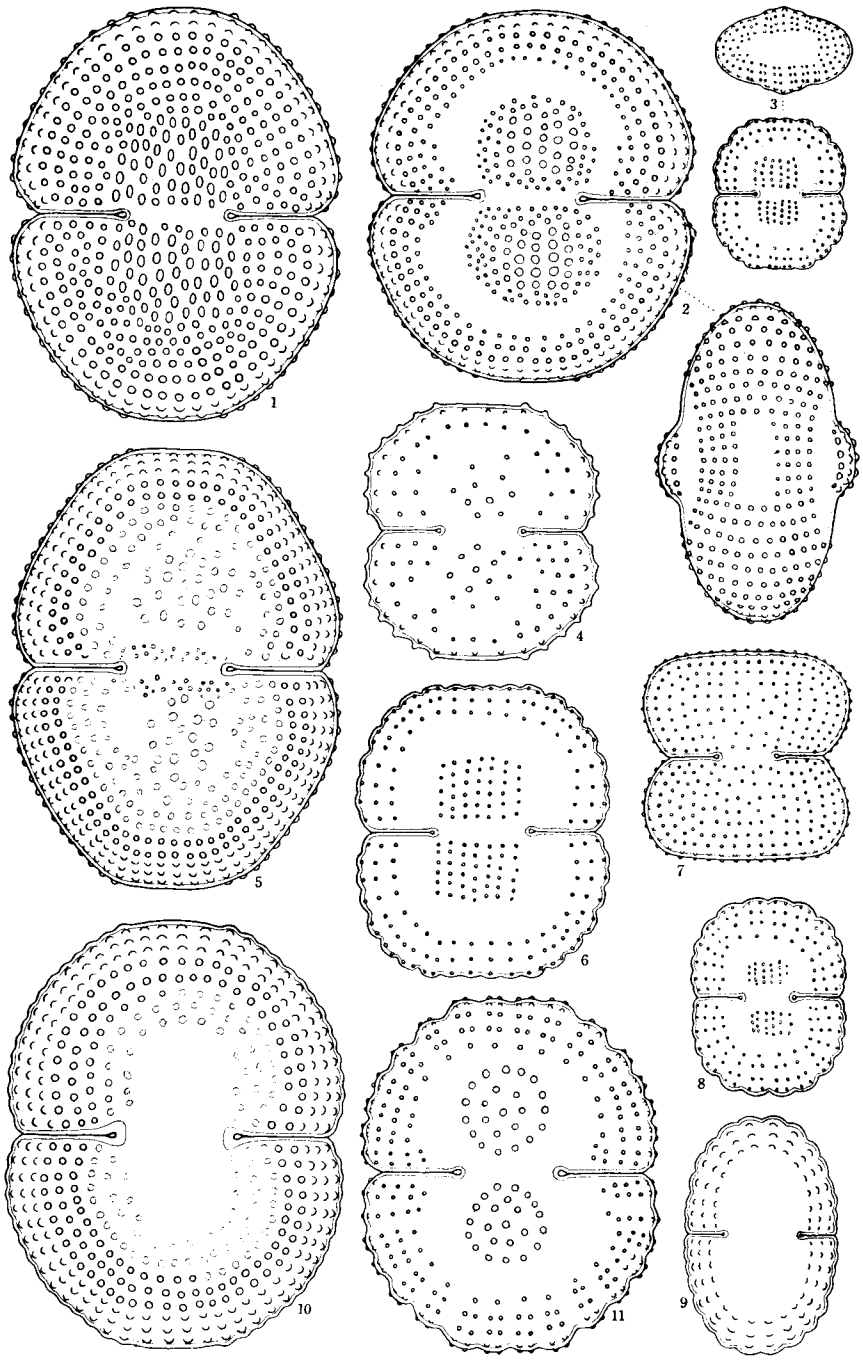

Plate 10

1. *Staurastrum boldtianum* GRÖNBLAD p. 43
2–3. *Euastrum subalpinum* MESSIK. p. 41
4. *E. elegans* (BRÉB.) KÜTZ. p. 40
5. *Staurastrum brevispinum* BRÉB. var. *retusum* BORGE p. 44
6. *St. insigne* LUND. p. 46
7. *Euastrum pectinatum* BRÉB. var. *brachylobum* WITTR. p. 41
8. *E. obesum* JOSHUA p. 40
9. *Staurastrum mucronatum* RALFS var. *subtriangulare* W. & G. S. WEST p. 47
10. *St. brevispinum* var. *boldtii* LAGERH. p. 44
11. *Arthrodesmus triangularis* LAGERH. var. *alaskanum* HIRANO, var. nov. p. 38
12. *A. ralfsii* W. WEST var. *brebissonii* (RACIB.) SMITH p. 38
13. *A. incus* (BRÉB.) HASS. var. *borgesenii* MESSIK. p. 37
14. *A. incus* var. *vulgaris* EICHL. & RACIB. forma *recta* EICHL. & RACIB. p. 37
15. *A. ralfsii* W. WEST var. *subhexagonum* (WEST) HIRANO, comb. nov. p. 38
16. *Xanthidium antilopaeum* (BRÉB.) KÜTZ. var. *crameri* GRÖNBLAD p. 38

1–16 : × ca. 700

Plate 10

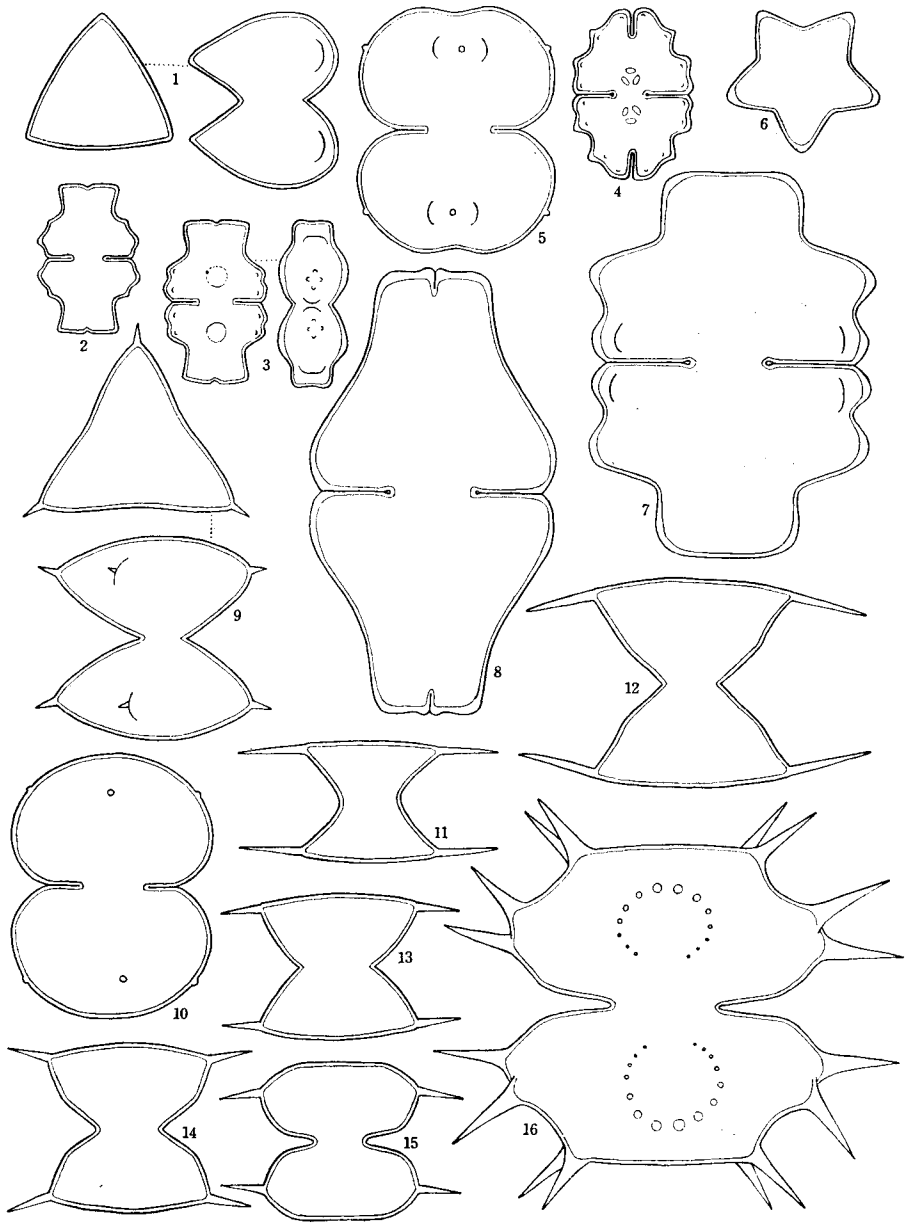

Plate 11

1–2. *Euastrum boldtii* SCHMIDLE p. 39

3. *Staurastrum punctulatum* BRÉB. var. *muricatiforme* SCHMIDLE p. 51

4. *St. pachyrhynchum* NORDST. forma *kossinskajae* CROASDALE p. 49

5. *St. pachyrhynchum* NORDST. p. 48

6. *St. capitulum* BRÉB. var. *spetsbergense* (NORDST.) COOKE p. 44

7. *Xanthidium fasciculatum* EHRENB. var. *ornatum* NORDST. p. 39

8. *Staurastrum bieneanum* RABENH. var. *ellipticum* WILLE p. 43

9. *St. granulosum* (EHRENB.) RALFS var. *acutum* (BRÉB.) W & G.S. WEST p. 46

10. *St. lunatum* RALFS p. 46

11. *St. aculeatum* (EHRENB.) MENEGH. var. *ornatum* NORDST. p. 42

12. *St. gronbladii* SKUJA p. 46

13. *St. bieneanum* RABENH. forma *spetsbergensis* NORDST. p. 43

1–13 : × ca. 800

Plate 11

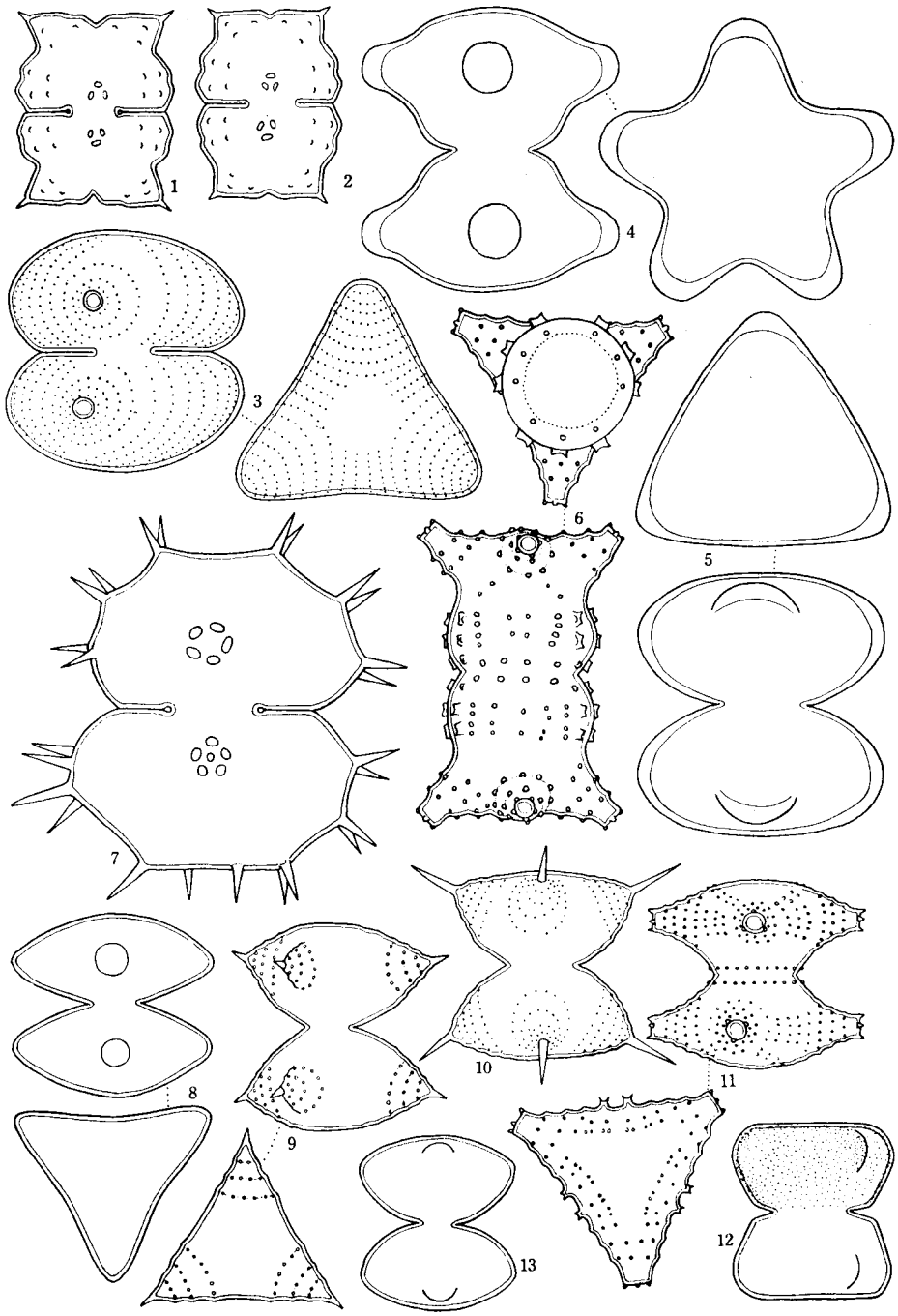

Plate 12

1. *Staurastrum oxyacanthum* ARCH. var. *croasdaleae* HIRANO, var. nov. p. 48
2. *St. lunatum* RALFS var. *planctonicum* W. & G. S. WEST p. 46
3. *St. sibiricum* BORGE p. 51
4. *St. monticulosum* BRÉB. var. *alaskanum* HIRANO, var. nov. p. 47
5. *St. brebissonii* ARCH. p. 44
6. *St. aculeatum* (EHRENB.) MENEGH. var. *ornatum* NORDST. forma *simplex* BOLDT p. 42

7–8. *St. borgeanum* SCHMIDLE p. 43

9. *St. petsamoense* (BOLDT) JÄRNEFELT var. *minus* THOMASSON p. 49
10. *St. pendulum* NYGAARD var. *pinguiforme* CROASDALE p. 49

1–12 : × ca. 800

Plate 12

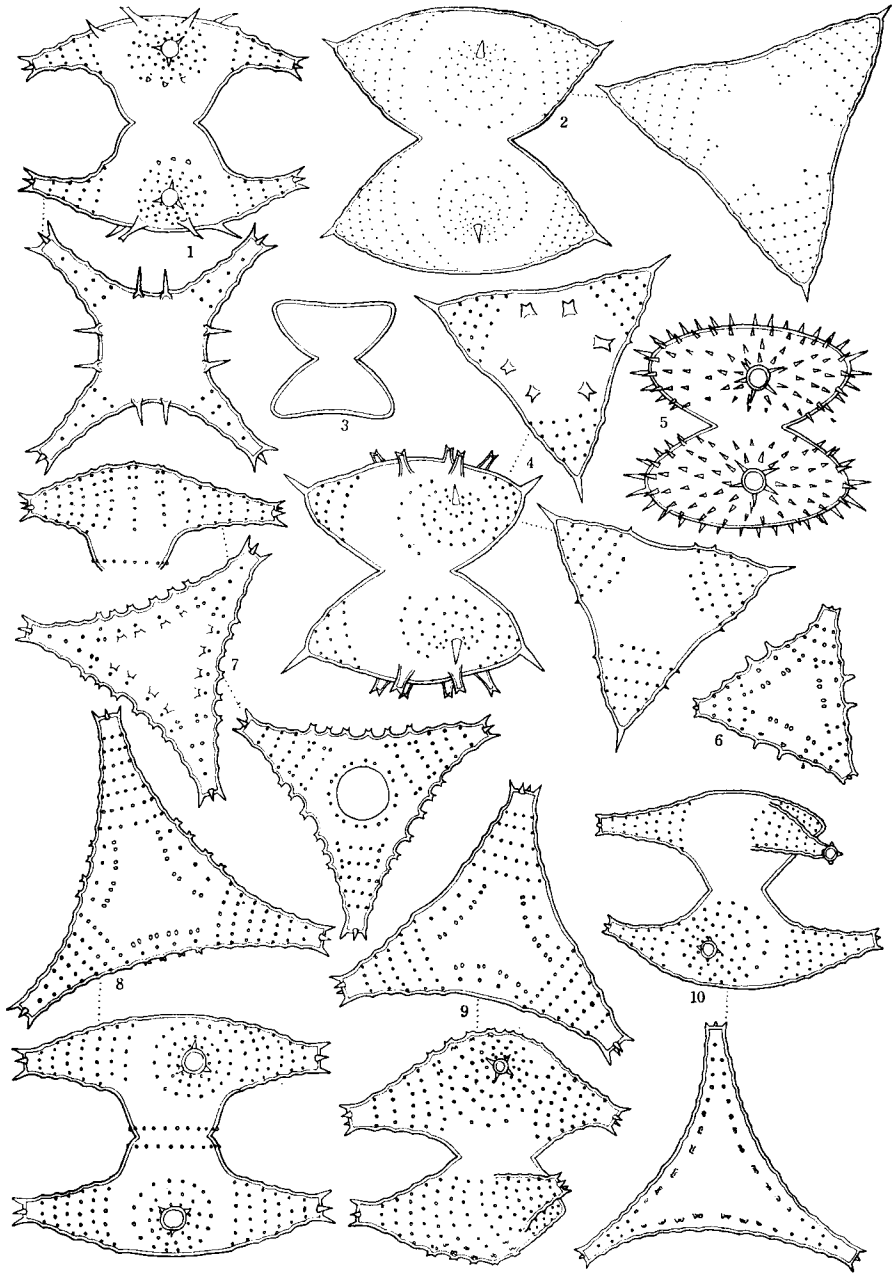

Plate 13

1–3. *Staurastrum petsamoense* (BOLDT) JÄRNEFELT p. 49

4. *St. oxyacanthum* ARCH. var. *sibiricum* BOLDT p. 48

5. *St. senarium* (EHRENB.) RALFS var. *nigrae-silvae* SCHMIDLE p. 51

6. *St. petsamoense* (BOLDT) JÄRNEFELT p. 49

7. *St. alternans* BRÉB. var. *basichondrum* SCHMIDLE p. 43

8. *St. borgeanum* SCHMIDLE p. 43

9. *St. petsamoense* (BOLDT) JÄRNEFELT var. *minus* THOMASSON p. 49

1–9 : × ca. 700

Plate 13